Department of Veterans Affairs

Veterans Health Initiative

Veterans and Radiation

Independent Study Course

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DEPARTMENT OF VETERANS AFFAIRS
Veterans Health Administration
Washington DC 20420

MESSAGE FROM THE UNDER SECRETARY OF HEALTH

I commend you for choosing to take advantage of this self-study program, "Veterans and Radiation." This reflects your commitment to continuing professional development and your recognition of the unique needs and challenges which veterans may present to medical care providers.

While the occupation of Hiroshima and Nagasaki occurred more than 50 years ago and U.S. atmospheric nuclear weapons tests ended in 1962, many of the approximately 400,000 participants (often called Atomic Veterans) and their families continue to be concerned that ionizing radiation caused the veterans' illnesses, especially cancer, and also may be responsible for health problems in their offspring. Other veterans also may have been exposed to ionizing radiation including nuclear submariners and veterans of the Gulf War who came into contact with depleted uranium (DU). Greater knowledge about radiation will enable VA staff to better address concerns of these and other radiation-exposed veterans.

This program is one of the educational modules of the Veterans Health Initiative (VHI). The VHI is intended to focus greater attention on the connection between significant events that occurred during military service and later health conditions. Greater understanding by VA providers of such linkages and of recommended evaluation and treatment approaches should contribute to enhanced health care and satisfaction for veterans, whether choosing to use the VA system or by receiving fair and thorough compensation examinations.

I would like to encourage you to participate in the other VHI educational modules. VA staff in the designated professional disciplines (currently including physicians, dentists, advanced practice registered nurses, and physician's assistants) who successfully complete 8 VHI educational modules will receive the Special Recognition in Veterans Health award.

Thank you for your participation in the VHI program and your service to veterans.

Thomas L. Garthwaite, M.D.
Under Secretary for Health

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Independent Study Outline

Purpose

This independent study provides information to VA staff about radiation. In particular, the program provides information about:

- Ionizing and non-ionizing radiation
- Major types of exposures to radiation that veterans may have experienced in service and health effects possibly associated with such exposures
- Special programs including the VA's Ionizing Radiation Registry Examination and Depleted Uranium programs
- Adjudication of radiation-related compensation claims; and
- Radiation exposures in VA facilities.

While the atomic bombing of Hiroshima and Nagasaki occurred more than 50 years ago and U.S. atmospheric nuclear weapons tests ended in 1962, many veterans who served in the Japanese occupation or who participated in atmospheric nuclear weapons tests and their families continue to be concerned that ionizing radiation (IR) has caused the veterans' illnesses, especially cancer and also may be responsible for health problems in their offsprings.

Other veterans may have been exposed to IR, such as nuclear submariners and veterans of the Gulf War who came into contact with depleted uranium (DU). Also, future limited conflicts may expose U.S. personnel to IR, (e.g., with increasing availability of DU on the international arms market). In addition, exposure to non-ionizing radiation (NIR) is of concern to veterans, such as those who worked with radar.

Knowledge about IR will permit staff to better respond to patients or research subjects who are concerned about radiation risks and to address issues relating to radiation safety. Moreover, while the threat of a nuclear war has receded, civilian nuclear accidents with potential exposure of populations to IR (such as occurred Three Mile Island and Chernobyl) are a continuing concern and terrorists may seek to make use of nuclear weapons and radioactive material.

Greater knowledge about radiation also will permit better understanding of such public policy issues as irradiation of food, storage of nuclear waste, safety of nuclear power, possible risks from use of cellular telephones and power lines, etc.

Veterans and Radiation

Objectives

Upon completing this self-study program, participants should be able to:

1. differentiate ionizing and non-ionizing radiation;
2. identify the major types of radiation;
3. ascertain the major types of exposure to radiation that veterans have experienced and special VA programs available;
4. identify average doses of ionizing radiation to which atomic veterans were exposed;
5. explain health effects that veterans may have experienced as a result of exposure to radiation;
6. describe health of offspring of Japanese atomic bomb survivors;
7. utilize the VA's Ionizing Radiation Registry Examination and Depleted Uranium programs;
8. ascertain how treatment for conditions possibly related to radiation is provided; and
9. understand how radiation-related compensation claims are adjudicated.

Outcome

As a result of this program, clinicians should be able to apply the knowledge gained to conduct more comprehensive evaluations and provide appropriate care to radiation-exposed veterans. Staff also should be able to better respond to questions and concerns of radiation-exposed veterans and their families, and assist in adjudicating their claims.

Target Audience

This independent study is designed for VA staff especially physicians, nurse practitioners, and physician assistants providing primary care, staff appointed as Registry Physicians and Registry Coordinators, clinicians performing Compensation and Pension examinations, Ionizing Radiation Registry and depleted uranium examinations, and staff involved in adjudication of radiation claims.

1. RECOLLECTION OF F. LINCOLN GRAHLFS

PARTICIPATION IN NUCLEAR TESTING *by F. Lincoln Grahlfs, Ph.D.*

In 1945 I was leading quartermaster on an ocean going tug USS ATA 199. On July 29 we left Okinawa towing the USS Hugh W. Hadley (DD 774) which had been hit by two kamikaze planes. We were to tow her to San Francisco where she would be repaired. We left Okinawa in a convoy, but just two days out we encountered a typhoon which scattered the convoy, and we proceeded independently to Saipan. It was there that we learned of the atomic bombing of Hiroshima and Nagasaki, and of the Japanese surrender.

My recollection of that time is one of greatly mixed feelings. We had all been so conditioned to think of the Japanese as "the enemy" and not as individual people like ourselves. But as report of the destruction caused by this new weapon reached us, I was just a little overwhelmed by its implications. It had been our expectation that we would return to participate in the invasion of the Japanese home islands. With the war over, we no longer faced that prospect. At the same time, we would now make the rest of the voyage alone, and with running lights on. All during the war, we had observed blackout conditions, and by contrast, those lights really looked bright. We all hoped we did not encounter a Japanese submarine whose captain had not heard that the war was over. A tug with a tow is not very maneuverable and would be an easy target. But the rest of the voyage was relatively uneventful and we arrived safely at San Francisco in late September.

While we were in San Francisco, we received word that the government was planning a major test of the atomic bomb's effectiveness when used against naval vessels, and soliciting volunteers for the operation. I distinctly remember my commanding officer remarking that a man would have to be crazy to volunteer for something like that. I do not know how many volunteers they got, but obviously, it was not enough. In April 1946, I was transferred to the USS ATR 40, a rescue tug, and within weeks, we were on our way to Bikini to participate in Operation Crossroads. That July we would witness the first two atmospheric detonations of nuclear weapons since their use on the Japanese cities of Hiroshima and Nagasaki. Between then and 1962, in the Marshall Islands and in the Nevada desert, well over two hundred more such detonations would occur and almost a quarter million military personnel would be involved. I, like most of the others, most emphatically had NOT volunteered for this assignment.

The ATR 40 was, in fact, attached to the salvage unit whose principal job, essentially, was to keep the target vessels afloat after the bombing so the damage to them could be assessed. In that capacity, we reentered the target area just a few hours after each of the two atomic explosions.

After spending the summer in the Marshall Islands, we returned to San Francisco with a long stopover in Pearl Harbor. We were in Pearl Harbor Navy Yard on Navy Day (October 27) when, for the first time since the war, the tradition of inviting the public aboard was to be observed. For the occasion, our ship had a large sign which said NO VISITORS. It had been determined that the radiation hazard was too great to permit civilians aboard. However, we continued to live aboard that vessel until mid-January, when it was decommissioned, and I went on sixty days leave.

Upon returning from leave I was assigned to shore duty in the Twelfth Naval District (San Francisco) and I began hearing rumors that many of the participants in Operation Crossroads had been hospitalized. I was unable to learn any more than that. However, in May, I reported to Oakland Naval Hospital with an abscess on my face, a very high fever and, they ascertained an unusual white blood count. The admitting physician prescribed massive doses of penicillin and hot Epsom salt soaks, neither of which seemed to have any effect.

I began to wonder when they put me in a private room; enlisted men were usually relegated to wards with fifty or so beds. Before long I found myself being gawked at frequently by groups of five or six officers (medical officers, I assume) at a time, and I heard myself referred to as “the interesting case I told you about, doctor.” One afternoon many days later, a corpsman wheeled me down to the X-ray department, a shield was put over my eye, and they treated the abscess with X-ray. It cleared up, my blood count gradually became normal, and I was returned to duty. However, for a period of about nine months I experienced a series of boils all over my body.

Nobody mentioned radiation exposure to me but the day of my first X-ray treatment, an old commander said to me, “Son, when I was a country doctor we called this a hair of the dog that bit you.” Many years later, I obtained a copy of my service record and was astonished to find that there is no mention, there, either of my transfer to the hospital or of my return to duty. Following up on this, I managed, after considerable difficulty, to obtain a copy of my medical record. That document does indicate that I was treated at Oakland Naval Hospital in the spring of 1947. The entry is quite brief, and the diagnosis given is “cellulitis of the face.”

I completed my six-year enlistment, returned to college, obtained bachelor’s and master’s degrees and had a successful teaching career. Over the years I have had problems attributable to radiation exposure, but I never sought the Veteran’s Administration’s assistance with them. One reason for this, based on two previous encounters, was the anticipation of possible insensitivity and rebuff. My disability claim for partial hearing loss resulting from service-incurred injury had been denied. Worse, however, was an experience I had

while attending college under the GI Bill. There was an irregularity in the payment of my stipend and I went to the VA office to get it straightened out. When I explained my situation to the receptionist her response was, “You veterans make me sick.” I did not need that!

I was fortunate enough, through the years, to have had good employer-provided health care insurance so I got what I considered good care from private physicians. On several occasions, when I had a problem that I thought might be related to radiation exposure, I mentioned my atomic test experience. The military and the nuclear industry had done such a thorough public relations job that invariably the doctor would dismiss the idea that there was any connection. I concluded that if my private physician did not listen to such concerns I would never get any acknowledgment of the connection from the VA.

Significantly, one of those occasions occurred when I was diagnosed, in the early 1960’s, as having an overactive thyroid. Thirty years later, in connection with a routine physical checkup at the University of Michigan Health Center, a doctor was taking a medical history and I mentioned my military experience. Immediately upon hearing that I had been at Bikini he said, “Let me palpate your thyroid.” When he felt something, he called in an ENT specialist who confirmed that there was indication of nodules and I was referred to the nuclear medicine department at U of M Hospital where a scan confirmed the diagnosis and I now have it checked periodically. Finally, after all those years, someone in the medical profession acknowledged the connection!

Radiation is insidious. You cannot see it, smell it, taste it or feel it but on some level, you are aware that it can harm you. On top of that, radiation caused illness involves a long latency period. Thus, I spent half a century wondering whether I would suffer some weird and debilitating illness.

I was also concerned about the effects of radiation on the reproductive system. The irreverent Bikini joke about going back to San Francisco and telling all the girls that we could not get them pregnant was soon replaced by concern about the possibility of genetic problems being transmitted to our children. This became real for me when my daughter, who was conceived less than two years after my return from Bikini, experienced a series of problems with her endocrine system. It was after she had half of her pancreas removed at the age
of twenty that I began speaking out against continued development and testing of nuclear weapons. She died of cancer at the age of 46, three years after surgery for a brain tumor and for lung cancer.

I have, moreover, had difficulty accepting the fact that the government never availed itself of this wonderful opportunity for a follow up study to assess possible health effects of our experience. I have more recently come to the cynical conclusion that they really did not want (anyone) to know.

Because of my experience, I was convinced that nuclear weapons were "bad news." Not only did they constitute a level of devastation beyond reason; the radiation they produced also created a hazard for those who used them and for their descendants. I was upset by the extent to which I felt that the safety and well being of service personnel were being compromised, and I was incensed at the campaign of denial. I wanted my country to do better than that! Through it all, I wondered whether others with experiences similar to mine felt as I did.

When I retired, I decided to return to school and pursue a Ph.D. in sociology. When it came time to choose a dissertation topic, there it was. How do Atomic Veterans remember the experience, and what effect do those perceptions have on their current attitudes? We are a varied lot, and our attitudes vary, but my contacts with literally hundreds of Atomic Veterans reveal many common themes. I am not alone.

Like myself, I found that these men all consider themselves to be loyal, patriotic Americans. We served our country willingly; two thirds of us, in fact volunteered for military service (as opposed to being drafted). We were, however, subjected to an experience that to this time is unique in American military history. We participated in the test detonation of nuclear bombs and that experience has inevitably contributed to who we are.

A few men volunteered for the experience; most were ordered to participate. Some entire military units were assigned to the tests, but many of the men were sent on temporary assignment and organized into casual or provisional units, which were dispersed soon after completion of the particular exercises.

Most of us have little recollection of being informed at the time about radioactivity or its possible consequences. There are, in fact, strong indications that some of the tests included such objectives as ascertaining what effect exposure to radioactivity would have on a combat unit's effectiveness, or of conditioning men to perform under such conditions. It is conceivable that if either of these were the objective, someone in charge would conclude that informing the troops fully about radioactivity could possibly result in malingering or in contamination of the outcomes.

Almost three quarters of the men questioned identified the safety measures in conjunction with their particular tests as inadequate. Moreover, the question, "What safety measures can you remember being taken?" elicited a variety of responses, many of which revealed either incredible naiveté or extreme callousness on the part of these men's superiors. In fact, the tendency of senior military officers to see and treat enlisted personnel as though they were part of the expendable equipment is evident in the following incident, which occurred on my own ship.

Approximately three weeks after test BAKER, we were ordered alongside the target vessel, USS Pennsylvania, which was taking on water. We were to install submersible pumps so she could be kept pumped out. There was a radiological monitor from AEC aboard and he took readings with a Geiger counter aboard the "Pennsy." Then he consulted his tables and came up with a time limit, which he said constituted "maximum safe exposure" for anyone to be aboard that vessel.

A working party was sent over to begin the job, and after the designated length of time, they returned and a second party went over to continue. In this way, a succession of work parties followed one another until all the enlisted men in our crew had been over on the Pennsylvania. At this point, the job had not been completed, so our commanding officer got on the voice radio to the task group commander. He reported that all his men had been subjected to maximum safe exposure, that the job was not yet completed, and he was requesting instructions. I was on the bridge, next to the captain and was astonished to hear the response, loud and clear. It was, "Safe exposure, my ass; don't let that ship sink!"

The lack of information, before, during and after the tests, the perceived lax safety procedures, and the fact that many of the men had been assigned to special temporary aggregations formed exclusively for the test operations, along with the fact that very few had volunteered for this duty, fostered growth of what I choose to call the guinea pig syndrome. Perhaps this was best expressed by the veteran of Operation Castle who said, "Originally I held the government blameless. As time passes and more is revealed I more strongly believe that we were test subjects." Test subjects, it should also be noted, from whom informed consent had not been obtained.

As both nuclear arms and nuclear power industries grew, there were a number of incidents, which resulted in greater public awareness of, and sensitivity to associated radiation hazards. With this development, some Atomic Veterans who had previously felt constrained to silence were encouraged to voice their concerns. Others who had not previously been concerned began to re-examine their experience. Many of us began seeking one another out. There developed, among us, an increased awareness that we had played a special role which deserved recognition.

It is accepted military procedure to give awards for participation in particular operations, bonus pay for particularly hazardous duty, and both care and compensation for injuries sustained in the line of duty. When the government denies responsibility for the injuries, not only those seeking compensation, but also many of their fellow veterans perceive this as an attack on their credibility and integrity. The fact that there has been no other form of recognition is seen as a denial that what we did had any importance.

A number of the veterans of Operation Crossroads recalled hearing a rumor at the time, that Admiral Blandy, the commander of that task force, had recommended that a campaign ribbon be awarded to all participants, but it had been vetoed by someone "higher up." When interviewing a man who had been on the admiral's staff at the time, therefore, I raised the question directly. This man indicated that, indeed, the recommendation had been made, but he did not know why it had failed to go through. Looking back, maybe they should have listened to the admiral.

For some the question was addressed very early; for others it came much later; eventually, however, anyone who has had any association with nuclear devices must begin to wonder about the possibility of related health effects. Although radiogenic illness can become manifest within days, a latency period of considerable length is much more frequently the case. Thus, it was the mid 1970's when a significant number of Atomic Veterans began to have physical problems which they attributed to their radiation exposure. Establishment of the several survivors' organizations was motivated principally by government denial of responsibility for these problems.

In my study, 46% of the respondents said they had health problems they felt were caused by exposure to radiation, and another 12% indicated that they were not sure. Similarly, 21% reported that some member or members of their family had health problems which they felt were related to their radiation exposure, and another 7% had some suspicion that this might be the case. In all, 60% of the men are in one or more of these categories. However, well over half of them (74% of the sample) report having worried about such possibilities. To a large extent these tend to be the same people who asserted that they felt that participation in nuclear weapons testing exceeded "...what is ordinarily regarded as appropriate military service."

In a 1965 article about the Japanese A-bomb survivors, Abe Rosenthal of the New York Times notes that certain doctors, both Japanese and American, talk about what they call "atomic hypochondria" "But," he goes on to say, "they say that pragmatically it does not make much difference whether the illnesses are atomic, imaginary, or real but quite nonatomic." In any case, as far as the veterans are concerned, the problem is real in the eyes of the men who experience it, and therefore should command attention by the government.

Furthermore, it is important to note that of the 161 men in my study who said they had a health condition they attributed to radiation exposure only 86 (53%) had filed claims with the Veterans Administration. And of the 40 who said they had a health problem and did not know, or wondered whether it was the result of exposure to radioactivity, 10 (25%) had filed claims. Such proportions seem not to support any assertion that those who claim radiogenic illness are malingerers seeking a "handout."

Many Atomic Veterans acknowledged having felt alienated, frustrated and isolated for many years because they had little contact with anyone who had shared their experience and nobody else seemed to think it was important. In fact, 79% of them indicated that they had, at least some of the time, wished they had someone with whom they could discuss their nuclear test experience. Some who joined the traditional veterans organizations report feeling rebuffed when they tried to discuss nuclear test experiences in that company. For some of these men the growth of radiation survivors' organizations has provided a boost for their self-image and their morale.

Many of us were explicitly admonished not to discuss the experience with anyone. Reported feelings about the appropriateness of this enforced silence vary. Nevertheless, feelings, particularly negative ones, that one is denied the opportunity to express, tend to grow. It is somewhat analogous to rust which has been painted over. The combination of denial by official sources and not being able to talk the matter out has caused the resentment to fester and grow beneath the surface just as rust, when painted over, eats away, unseen, at the metal.

Probably the one feeling most often expressed by Atomic Veterans is a resentment of the denials, cover-ups and misrepresentations on the part of the government. By and large, these are men who served their country in a spirit of patriotism. Many feel that in the course of that service they were exposed to unnecessary hazards without either knowledge or consent. But their resentment of this would be much less if they felt that the government had been and was currently being completely "straight" with them.

It makes no sense for a government to alienate its greatest potential support, the men and women who fought for it. My study gives convincing indications that veterans will support government very faithfully, in spite, even, of perceived slights; but the thing that can alienate them is a failure to be honest and up front with them.

In most respects, Atomic Veterans are not appreciably different from other veterans of our generation (essentially those born between the two World Wars). We have a strong sense of patriotism; we generally support a strong military stance by the United States and that support tends to increase when association with the military is longer and closer. Atomic Veterans have a healthy respect for the tremendous power of nuclear weapons. We are

realistic enough to recognize that the existence of these weapons has become a fact of life; as long as this is so most of us feel that the US should not relinquish its superiority in nuclear weapons. But, at the same time, many deplore the nuclear buildup of the cold war period and a majority feel that nuclear tests should be either stopped or very strictly regulated.

Many Atomic Veterans are seriously concerned about health effects of exposure to radiation and a significant number feel that they have experienced these effects. However, we are generally aware that military service is a hazardous occupation and that risks must be accepted. What dissatisfaction there are focuses more on how both the risks and the injury claims have been managed.

Most importantly, in conversations with these men, in their letters, and in their marginal comments on questionnaires, it becomes evident that there is a strong feeling of resentment among a considerable number of them which can best be described as a feeling of "being used." Four of their most frequently voiced complaints are; that they were not adequately informed about the risks involved; that safety procedures were either inadequate or ignored; that the government has refused to acknowledge these faults; and that they were never given proper recognition for their participation.

But, although the experience which invokes those feelings was incident to military service, most of their resentment is not particularly focused on the military, as such. More of that resentment is directed toward congress, whose members are perceived as giving inadequate attention to the complaints of the veterans and toward the Veterans Administration and the Defense Nuclear Agency, because of their role in the "denial" process.

Quite clearly, Atomic Veterans, like Americans in general, vary widely in their opinions and attitudes. Among them, continuing military experience understandably leads to stronger endorsements of the military and of government actions supporting the military, but it does not seem to have any bearing on attitudes and opinions that range outside the zone of the military. There is no evidence here that the military creates someone who is predictably conservative across multiple dimensions.

Of course, the unusual experiences of these particular veterans has imbued very many of them with what can only be described as a combination of outrage, distrust and resentment toward various aspects of the federal government. In short, these are men who want very much to trust, believe in and support their government. How foolish of that government to alienate them by not listening more sympathetically to their concerns!

[See Grahfls, F.L., Voices from Ground Zero Recollections and Feelings of Nuclear Test Veterans, 1996, for more detailed information.]

2. INTRODUCTION

There are a number of circumstances under which veterans might have been exposed to radiation. Their eligibility for VA services (such as for the VA's Ionizing Radiation Registry (IRR) Examination Program, priority to enroll for VA health care, requirement to make co-payments for VA treatment, required documentation in their service records, etc.) also varies depending on the nature of their exposure and the diseases for which care is sought.

This program includes information about major types of exposure and summarizes available scientific information and special programs available for veterans.

If a veteran is not eligible for the IRR Examination Program but is concerned about his or her radiation exposure and has other eligibility for VA care (e.g., is enrolled), it is recommended that an evaluation comparable to the IRR examination be offered (although the results would not be entered into the IRR database).

Resources for possible assistance in responding to veterans' questions

A VA Fact Sheet about programs for veterans exposed to ionizing radiation is available (**Appendix 1**).

Each VA Medical Center has a Registry Physician and Registry Coordinator who are responsible for the IRR Examination Program (**Appendix 2**) as well as the Depleted Uranium (DU) screening program (**Appendix 3**), which is part of the VA's Gulf War Registry Examination program.

A VA Fact Sheet about nasopharyngeal (NP) radium therapy is available (**Appendix 4a**).

Each VA facility has a Health Administration Service or comparable office which can assist with questions about eligibility for VA care, enrollment, co-payments, reimbursement for travel costs, etc. Also, veterans may call toll-free 877-222-8387 for enrollment information.

Questions related to compensation claims can be referred to Veterans Benefits Administration staff located at many VA facilities or veterans may reach their local VA Regional Office (VARO) by calling toll-free 800-827-1000.

Atomic veterans with questions about radiation doses which they may have been received in Hiroshima, Nagasaki, or as atmospheric nuclear weapons test participants may call the Defense Threat Reduction Agency (formerly the Defense Special Weapons Agency and Defense Nuclear Agency) toll-free at 800-462-3683.

Doses of radiation to which other veterans may have been exposed may be included in their service records (e.g., recorded on DD 1141 forms) (which may be available through the VAROs if compensation claims have been filed) and/or information may be available from the radiation dosimetry offices of the individual military services. See **Appendix 5** for addresses to request dose information.

A facility's radiologists, nuclear medicine specialists and the radiation safety officer may assist in responding to scientific and technical questions about ionizing radiation and possible health effects.

The Office of Public Health and Environmental Hazards, which is administratively responsible for the VA's Ionizing Radiation Program, may be reached at 202-273-8575.

3. BACKGROUND INFORMATION ABOUT RADIATION

The term "Ionizing radiation" (IR) refers to a group of subatomic particles and electromagnetic waves or photons that have enough energy to create ions (electrically charged particles) when they interact with atoms or molecules.

Commonly encountered types of IR include alpha particles, beta particles, gamma rays and X-rays.

- Alpha particles, which are emitted from atomic nuclei and which are identical to nuclei of helium atoms, are not able to penetrate the intact skin. Therefore, alpha emitters are hazardous primarily if they are taken into the body and function as sources of internal radiation.

- Beta particles are high-energy electrons emitted from atomic nuclei. They can penetrate a short distance into the body but beta emitters are hazardous primarily if they are taken into the body and function as sources of internal radiation.

- Gamma rays which are electromagnetic rays originating in nuclei can penetrate the body readily so both external and internal gamma sources are hazardous.

- X-rays are similar or identical to gamma rays but originate outside the atomic nuclei.

- Neutron particles emitted from atomic nuclei are another type of IR to which some veterans were exposed (e.g., immediately after atomic weapons explosions).

Sources of IR include radioactive decay of unstable atoms in radioisotopes, nuclear fission (splitting of the atom such as in a nuclear reactor or detonation of an atomic bomb), nuclear fusion (fusion of atoms as in detonation of a hydrogen bomb), and mechanical devices, such as X-ray machines.

The term "non-ionizing radiation" (NIR) refers to various types of electromagnetic radiation which do not create electrically charged particles when they release energy into matter. However, NIR still may cause acute and chronic adverse health effects.

Examples of NIR include (in the order of decreasing frequencies and increasing wavelengths) ultraviolet radiation, visible light, infrared radiation, radar and other microwave radiation, radio frequency radiation, and extremely low frequency radiation such as associated with electric power lines.

External versus internal exposure to IR

- External radiation refers to IR from a source located outside the body. With external radiation, the body absorbs radiation only as long as it is exposed to the outside source and only portions of the body that are exposed absorb the radiation. Generally, the skin receives the highest dose from external IR. The dose to the deeper tissue is utilized as the whole body dose when the entire body is radiated.

- Internal radiation refers to IR from a source that has been taken into the body, such as by inhalation, ingestion, wounds, etc. Absorption of radiation may continue for a long period of time after a radioactive material has been taken into the body, depending on the physical and biological half-lives of the radioactive material. IR from an internalized source may be concentrated in a particular part of the body; e.g., radiation from internalized iodine 131 will be concentrated in the thyroid gland. Generally, doses from internal IR are reported as the calculated dose that would be received over 50 years, e.g., the 50-year committed dose equivalent.

Measurement of IR exposure and doses – Ionizing radiation can be measured with a variety of instruments including personal dosimetry devices such as film badges. Film badges primarily measure exposure to external gamma and X-rays. These have been replaced by more accurate thermo luminescent dosimeters (TLDs), which measure exposure from gamma, neutrons and skin doses.

Determination of internal radiation doses tends to be more difficult than external radiation doses and physiological and mathematical models may be used. These include direct measurements using external detection devices (e.g., whole-body counting) and testing of materials excreted or removed from the body (e.g., bioassays).

Biological dosimetry refers to the estimation of radiation exposure by measuring changes to various body constituents such as chromosome aberrations. These techniques tend to be more accurate at higher radiation doses (e.g., about 10 rem or higher) and may be affected by other exposures besides radiation.

- Roentgen (R or sometimes r) – measures exposure based on ionization of air, 1 R is the amount of x-ray or gamma radiation that results in an electric charge of 2.58×10^{-4} coulomb per kg of air.

- Rad – "Radiation absorbed dose" – measures the amount of energy deposited in tissue; 1 rad is defined as the amount of radiation that deposits 100 ergs per gram; 100 rads equals one Gray

- Rem – "Radiation (or Roentgen) equivalent man" – Use of equivalent doses adjusts for the different biological effects of different types of radiation. Essentially a rem is the dose of any form of IR that is estimated to have the same biological effect as 1 rad of gamma or x-rays. To obtain the dose in rem, the dose in rads is multiplied by the weighing factor (sometimes referred to as the "relative biological effectiveness" (RBE) or "quality factor") for the type of radiation. The radiation-weighing factor is 1 for beta, gamma and X-rays, 20 for alpha particles, and 5-20 for neutrons. 100 rem equals one Sievert.

- For gamma and X-rays, exposure in Roentgens is approximately the same as absorbed dose in rads and equivalent dose in rem (e.g., an exposure of 1 R, would result in an absorbed dose of about 1 rad and an equivalent dose of about 1 rem).

- The "effective dose" is a calculated dose to convert a partial body or non-uniform dose into a whole body dose that would have the same degree of risk principally from cancer; to calculate the effective dose, the dose to the organ or tissue is multiplied by the tissue's weighing factor which reflects its relative susceptibility.

- "Committed" dose – Amount of radiation received from an internal source of IR to a particular organ over a period of time, usually 50 years.

- The total dose is the sum of the external and internal doses (e.g., effective dose equivalent for external radiation plus committed effective dose equivalent for internal radiation).

TABLE I
SOME COMPARATIVE DOSES OF IONIZING RADIATION

- Chest X-ray – 0.015 rem
- The average dose of IR that a person in the U.S. receives from natural background, medical and other exposures – 0.4 rem per year
- Average external dose of participants in U.S. atmospheric nuclear weapons tests according to the Defense Threat Reduction Agency (DTRA) – 0.6 rem
- Maximum dose of U.S. personnel involved in occupation duties in Hiroshima or Nagasaki according to the DTRA – less than 1 rem
- The annual occupational limit for radiation workers from IR mandated by the U.S. Nuclear Regulatory Commission (NRC) – 5 rem per year. [The 5 rem annual occupational limit is the total effective dose equivalent. The NRC permits higher doses to parts of the body, e.g. 50 rem per year to the skin or extremity.]
- Average dose received by Japanese atomic bomb survivors in Hiroshima and Nagasaki – about 20-200 rads
- Symptoms of acute radiation sickness – not expected at whole-body doses of less than about 100 rem
- Approximate acute whole body dose resulting in about a 50% likelihood of death in 30 days – about 400 rads

NOTE: A rem is the amount of any type of ionizing radiation estimated to have the same biological effect as 1 rad of X-rays or gamma rays. For virtually all radiation associated with medical procedures, exposures expressed in rads or rem would be interchangeable.

4. ADVERSE HEALTH EFFECTS FROM RADIATION

Ionizing Radiation (IR)

- Deoxyribonucleic acid (DNA) generally is the critical site for damage from low level IR. In addition, IR can damage other molecules and cellular components such as lipids, enzymes and other proteins, ribonucleic acid (RNA), cellular membranes, mitochondria, etc.
- Rapidly dividing poorly differentiated cells (e.g., in bone marrow and GI tract) tend to be more susceptible to IR.
- Acute effects from exposure of the whole body or large portions of the body to high doses of radiation (e.g., 50-100 rads or more) include a number of acute radiation syndromes involving the central nervous, cardiovascular, gastrointestinal and hematopoietic systems. Signs and symptoms include nausea, vomiting, diarrhea, prostration, bleeding, infections, hair loss, and neurological derangement. Rapidity of onset of symptoms, severity of medical problems, and likelihood of death are related to dose.
- "Stochastic" effects are those related to probability, such as induction of cancer or genetic mutation. The likelihood (but not the severity) of the disorder is increased as the dose of IR increases. Generally stochastic effects are not felt to have a threshold; i.e., it is assumed that there is no "safe dose", at least for radiation safety purposes.
- Radiogenic malignancies – A malignancy thought to be caused by IR is indistinguishable pathologically from one thought to be caused by another factor. Generally it is not possible to determine definitely whether a stochastic effect such as cancer in an individual has been caused by IR. Usually the most that can be provided is an estimate of the likelihood that IR was responsible. The calculated estimate sometimes is called the "probability of causation" (PC) or "assigned share". Generally malignancies and other tumors resulting from exposure to IR develop years later, after a latency period. Treatment of malignancies and other diseases thought to be due to IR is identical to the treatment of the same conditions when IR is not suspected to be responsible (unless the radiation-induced malignancy is in the field of the previous therapeutic radiation which would limit further use of this treatment modality).

- "Deterministic" effects are those that increase in severity as the dose of IR increases. Examples of "deterministic" effects include acute radiation syndromes following acute whole body doses of 50-100 rads or more and non-neoplastic complications from radiation therapy affecting various organs. Generally no clinically significant deterministic effect is likely to occur at a dose below 10 rem. Thresholds may be much higher for specific conditions (e.g., about 60 rads or more for cataracts).

Treatment of conditions thought to be due to radiation is provided by the same specialists who would be involved if radiation was not suspected of being responsible. For instance, cataracts would be treated by an ophthalmologist, leukemia by a hematologist, etc.

Sources of information about adverse health effects of IR

The major source of information about the effects of IR on humans has come from studies of Japanese atomic bomb survivors and their offspring. Findings of these studies are summarized in **Table 2** on the following page. Other sources of information include patients who received radiation therapy or other forms of medical radiation, individuals exposed after nuclear accidents such as Chernobyl, etc. Children tend to be more sensitive to the adverse effects of radiation than adults are and women tend to be more sensitive than men are.

TABLE 2
STUDIES OF JAPANESE A-BOMB SURVIVORS

Significant radiation-related increases

Malignant tumors: leukemia, cancers of the breast (female), colon, liver, lung, ovary, skin (non-melanoma), stomach, and thyroid

Cataracts

Prenatally exposed: small head size, mental retardation, diminished IQ and school performance, increased frequency of seizures

Survivors exposed at young age or prenatally: retarded growth and development

Chromosome abnormalities in lymphocytes

Somatic mutation in erythrocytes and lymphocytes

Suggestive radiation-related increases

Malignant tumors: cancers of the esophagus, urinary bladder, malignant lymphoma, salivary gland tumors, possibly multiple myeloma

Prenatally exposed: adult-type malignancies

Exposed in utero: impairment of neuromuscular development

Parathyroid disease

Mortality from diseases other than malignant tumors, specifically cardiovascular disease and liver cirrhosis at higher doses

Specific (humoral or cell-mediated) changes in immunologic competence

No radiation-related increases seen to date

Malignant tumors: chronic lymphocytic leukemia, osteosarcoma

Acceleration of aging

Sterility or infertility among the prenatally or postnatally exposed

Children of survivors: congenital abnormalities, mortality including childhood cancer, chromosome aberrations and in biochemically identifiable genes

(Source: Schull, Effects of Atomic Radiation A Half-Century of Studies from Hiroshima and Nagasaki, 1995, pp 272-273)

Non-Ionizing Radiation (NIR)

Ultraviolet (UV), visible, infrared and microwave radiation may cause various types of eye damage. UV, infrared, and microwaves may contribute to cataracts in some circumstances (e.g., high-energy microwave exposure).

The effects of UV radiation generally are limited to the skin and eyes because of its limited penetration ability. UV radiation in sunlight is the major risk factor for skin cancer.

Concerns have been expressed about possible non-thermal adverse health effects, especially cancer risk, from exposure to radio frequency and microwave radiation (which include radios, cellular telephones, and radar). According to a Food and Drug Administration consumer update from 10/20/99, the available scientific evidence does not allow one to conclude that mobile phones are absolutely safe or unsafe. However, the available scientific evidence does not demonstrate any adverse health effects associated with the use of mobile phones. A 1995 report from the National Institute for Occupational Safety and Health (NIOSH) on radar concluded that there were too few and too limited data either to suggest that low-level microwaves could adversely affect health in humans or exonerate such exposure. A 1998 World Health Organization fact sheet concluded that based on current scientific information exposure to radio frequency fields is unlikely to induce or promote cancers.

Concerns have been expressed about possible adverse health effects – especially cancer, from exposure to extremely low frequency (ELF) electric and magnetic fields (EMF) related to electric power. In a report released in June 1999, the National Institute of Environmental Health Sciences (NIEHS) of the National Institutes of Health concluded that ELF EMF exposure cannot be recognized as entirely safe because of weak scientific evidence that exposure may pose a leukemia hazard. The NIEHS did not believe that there was sufficient evidence of risk for other cancers or non-cancer health outcomes to warrant concern.

KEY REFERENCES ABOUT RADIATION

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http://www.fda.gov/cdrh/ocd/rnobilphone.html

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http://www.dtra.mil/news/facts/ntprvs.html

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National Institute of Environmental Health Sciences (NEIHS) Report on Health Effects from Exposure to Power-Line Frequency Electric and Magnetic Fields, 1999 –
http://www.niehs.nih.gov/emfrapid/html/EMF_DIR_RPT/Report_18f.html

National Institutes of Occupational Safety and Health (NIOSH) Fact Sheet EMFs in the Workplace **http://www.cdc.gov/niosh/emf2.html**

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5. ATOMIC VETERANS

The term “atomic veteran” is applied to individuals who served as occupation troops in Hiroshima or Nagasaki after the atomic bombing of those cities, some former POWs, and participants in atmospheric nuclear weapons tests.

U.S. Occupation Personnel

The first atomic bomb was dropped on Hiroshima on August 6, 1945 followed by the second bomb on Nagasaki on August 9. Both were airbursts, which therefore minimized radioactive debris.

Several surveys were made to determine that the U.S. occupation of the two cities could proceed safely.

The U.S. occupation of the Hiroshima area began on October 7, 1945 and lasted through March 6, 1946. The occupation of the Nagasaki area began on September 23, 1945 and lasted through June 1946.

Approximately 195,000 service personnel have been identified as members of the Hiroshima and Nagasaki occupation forces or were prisoners of war with potential for similar exposure to IR. None of the occupation forces had film badges to measure doses of IR.

According to the Defense Threat Reduction Agency (DTRA), formerly the Defense Nuclear Agency (DNA) and Defense Special Weapons Agency (DSWA), using all possible “worse case” assumptions, the maximum possible dose of IR that any member of the occupation force might have received at Hiroshima or Nagasaki from external radiation, inhalation, and ingestion is less than 1 rem. The DTRA reports that over 95% of these participants received doses below 0.1 rem and only those Nagasaki occupation forces that regularly entered the Nishiyama area had the potential to receive doses up to 1 rem. See **Appendix 6** for more detailed information.

An epidemiological follow-up study of U.S. occupational personnel was not felt to be cost-beneficial by the National Academy of Sciences.

Participants in U.S. atmospheric nuclear weapons tests

The world's first nuclear detonation was Project TRINITY which occurred on July 16, 1945 at Alamogordo, New Mexico and proved that that nuclear weapons were possible. Between TRINITY and the implementation of the limited test ban in 1963, the U.S. conducted over 200 atmospheric nuclear weapons tests in 21 test series. Most were conducted in Nevada Test Site or the Pacific Proving Ground (principally at Enewetak and the Bikini Atolls in the Marshall Islands) while one was conducted in New Mexico (TRINITY) and one in the Atlantic.

Among the problems and controversies associated with U.S. atmospheric nuclear weapons tests were the following:

- Involvement of some veterans in events that were or were believed by some to be experiments in connection with nuclear tests. Approximately 2000-3000 military personnel may have participated as research subjects.

  Examples of studies included psychological and physiological testing; testing of volunteers as close as under 1 mile from ground zero; flash blindness experiments (the only experiments in which immediate injury was recorded); research on protective clothing (including having personnel walk or crawl over contaminated ground as soon as 4 hours after the nuclear shot); cloud-penetration activities (resulting in radiation doses of 15 or higher R for several crew members); and decontaminating aircraft.

  Other atomic veterans who were not considered to be "research subjects" were engaged in similar activities.

  See **Appendix 7** for a summary of pertinent sections of the final report of the former presidential Advisory Committee on Human Radiation Experiments (ACHRE).

- Extensive radioactive contamination of target ships from the underwater detonation of shot BAKER of Operation CROSSROADS in 1946. This posed major decontamination problems for military participants and resulted in evacuation and resettlement of inhabitants of Bikini Atoll. [Some Navy veterans of the USS BRUSH who did not participate in CROSSROADS also have expressed concern about IR exposure since their ship was anchored near contaminated target ships that had been towed to Kwajalein Atoll and some crewmembers visited nearby target ships and collected souvenirs.] See **Appendix 8** for more information about CROSSROADS.

- Unexpectedly large amounts of radiation exposure and contamination from the shot BRAVO, of Operation CASTLE in 1954. This was a thermonuclear (fusion or hydrogen bomb-type) device with the largest yield ever tested by the U.S. Radioactive particles were spread over a much larger area than anticipated exposing Marshall Islanders, Japanese fishermen and U.S. personnel. Acute radiation effects were observed among some of the exposed fishermen. See **Appendix 9** for more information about CASTLE.

- Exposure by IR of residents who were "downwind" of nuclear weapons tests detonated in the continental U.S.

According to the DTRA, approximately 210,000 participants were involved in atmospheric nuclear weapons tests. About 45% of test participants had film badges. For personnel without suitable film badges, the DTRA uses 3 alternative approaches: determination of dose potential (e.g., from nuclear detonations or contact with radioactive materials); dose based on film badges of others with similar potential for exposure; and dose calculations (e.g., based on unique activities of specific individuals).

Gamma and X-rays accounted for most of the radiation exposure that test participants received. The average external radiation dose of test participants was 0.6 rem and less than 1 % of participants exceeded the current radiation occupational dose limit for radiation workers mandated by the U.S. Nuclear Regulatory Commission of 5 rem (whole-body) per year. According to the DTRA, about 1100 test participants received external doses of between 5 to 10 rem and about 140 received more than 10 rem.

Epidemiological follow-up studies of U.S. atmospheric nuclear weapons test participants are summarized in **Table 3**.

TABLE 3
STATISTICALLY SIGNIFICANT INCREASES IN MORTALITY IN STUDIES OF U.S. NUCLEAR WEAPONS TEST PARTICIPANTS*

STUDY NAME	OVERALL MORTALITY	SPECIFIC MORTALITY
CDC "Smoky" study[1]	[Not increased Observed/expected ratio 0.88 (95% Confidence Interval (CI) 0.78 – 0.98)]	Increased leukemia Observed/expected ratio 2.58 (95% CI 1.11 – 5.09)
VA "Hardtack" study[2]	Increase in all cause mortality Relative risk (RR) 1.10 (95% CI 1.02 – 1.19)	Increase in mortality from cancers of the digestive organs RR 1.47 (95% CI 1.06-2.04)
Med Follow-up Agency "Crossroads" study[3]	Increased Relative risk all-cause mortality 1.046 (95% CI 1.020 – 1.074)	
VA "5 Rem and Over" study[4]	Increased Relative risk all-cause mortality 1.22 (95% CI 1.04 – 1.44)	Increased for all lymphopoetic cancers; RR 3.72 (95% CI 1.28 – 10.83)
Med Follow-up Agency "Five Series" study[5] (corrected) (includes "Smoky" participants)	[Not increased All-cause hazard ratio 1.00 (95 % CI-0.98-1.02)]	Increased for external causes hazard ratio 1.08 (95% CI 1.02 – 1.16), nasal cancer 2.64 (95% CI 1.02 – 6.82), and prostate cancer 1.20 (95% CI 1.03 – 1.40)

* Only statistically significant findings from main studies (not subset analyses) shown. Summaries of these studies are provided in **Appendices 10a-10e.**

1. Caldwell et al., Mortality and Cancer Frequency Among Military Nuclear Test (Smoky) Participants, 1957 Through 1979, JAMA, Vol.250 Number 5, August 5, 1983, pages 620-624.

2. Watanabe et al. Cancer Mortality Risk among Military Participants of a 1958 Atmospheric Nuclear Weapons Test, Am J of Public Health, Volume 85, Number 4, April 1995, pages 523-527.

3. Johnson et al., Mortality of Veteran Participants in the CROSSROADS Nuclear Test, Medical Follow-up Agency, Institute of Medicine, National Academy of Sciences, 1996.

4. Dalager et al., Cancer Mortality Among the Highest Exposed U.S. Atmospheric Nuclear Test Participants, J Occup. Environ Med, Volume 42, Number 8, August 2000, pages 798-805.

5. Thaul et al., The Five Series Study: Mortality of Military Participants in U.S. Nuclear Weapons Tests, Medical Follow-up Agency, Institute of Medicine, National Academy of Sciences, 1999.

U.S. participants in non-U.S. nuclear weapons tests

Some U.S. service personnel were potentially exposed to IR as a result of activities relating to foreign nuclear weapons tests, such as cloud sampling missions.

It has been difficult to obtain dose information on this group of veterans although the Air Force currently is trying to address this problem.

VA programs for atomic veterans

See **Appendix 1** for Fact Sheet on VA Programs for Veterans Exposed to Radiation.

Ionizing Radiation Registry (IRR) Examination program – Atomic veterans are eligible to participate in the IRR Examination program. Veterans need not be enrolled in VA health care to participate in the IRR Examination program. The IRR includes a medical history, physical examination, and baseline laboratory studies. Additional specialized tests and consultations are provided as clinically indicated. This program potentially serves as an entry point for VA care. More information about the IRR Examination program can be provided by each VA Medical Center's Registry Physician or Coordinator. See IRR Handbook in **Appendix 2**.

As of August 1999, over 21,000 IRR examination code sheets have been submitted. See **Appendix 11** for analysis.

Special eligibility for VA Health care – Atomic veterans have special eligibility (Priority Level 6) to enroll in VA health care for treatment of conditions that VA recognizes as potentially due to radiation by statute or regulation (see Section 13 of this program). Care for these potentially radiogenic conditions is provided without regard to the veteran's age, service-connected status, or ability to defray the cost of medical care. Additionally, no co-payment by the veteran is required. Even if an eligible veteran has never filed a compensation claim or if the claim has been denied, the veteran can still receive free care for potentially radiogenic conditions. More information about eligibility can be provided by staff in each VA Medical Center's Health Administration Service (or other office with similar responsibilities depending on the facility's local organizational structure).

Concern about offspring

A continuing concern to atomic veterans is the possibility that health problems in their offspring may be related to IR.

Studies in offspring of Japanese atomic bomb survivors have not documented an increased risk of birth defects. Also among the Japanese no significant increased risk for deaths from childhood cancer or leukemia has been found with increasing parental dose of IR.

An analysis by the Medical Follow-up Agency of the National Academy of Sciences concluded that it would not be feasible to conduct an epidemiological study of U.S. atomic veterans to determine whether there is an increased risk of adverse reproductive outcomes. This conclusion was based on the expected extremely small potential risks at low doses of IR, the resultant need for a very large study population, and various other methodological difficulties. (See summary in **Appendix 12**.)

Review by Presidential Advisory Committee on Human Radiation Experiments (ACHRE)

The ACHRE considered issues of concern to atomic veterans. Some actions related to compensation but no additional medical screening or follow-up programs were recommended. See **Appendix 7** for summary of pertinent sections of the ACHRE Final Report.

See the recollections of Dr. F. Lincoln Grahlfs in Section 1 of this program for a discussion of concerns experienced by many atomic veterans.

KEY REFERENCES ABOUT ATOMIC VETERANS

Caldwell et al., Mortality and Cancer Frequency Among Military Nuclear Test (Smoky) Participants. 1957 Through 1979, JAMA, Vol. 250 Number 5, August 5, 1983, pages 620-624) (See summary in **Appendix 10a**)

Dalager et al., Cancer Mortality Among the Highest Exposed U.S. Atmospheric Nuclear Test Participants, J. Occupational and Environmental Medicine, Volume 42, Number 8, August 2000, pages 798-805 (See summary in **Appendix 10d**)

Defense Nuclear Agency (DNA), 6041F, For the Record A History of the Nuclear Test Personnel Review Program 1978-1993, March 1996 (See excerpts in **Appendices 6, 8, and 9**)

Defense Threat Reduction Agency (DTRA) Fact Sheets on Radiation Exposure in U.S. Atmospheric Nuclear Weapons Testing and Veterans Benefits Programs for U.S. Atmospheric Test Participants or Hiroshima/Nagasaki Occupation Forces – (**See Appendix 6**)
http://www.dtra.mil/news/fact/nw_ntprpre.html and
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Johnson et al., Mortality of Veteran Participants in the CROSSROADS Nuclear Test, Medical Follow-up Agency, Institute of Medicine, National Academy of Sciences, 1996 (See summary in **Appendix 10c**)

National Academy of Sciences, Institute of Medicine report Adverse Reproductive Outcomes in Families of Atomic Veterans; The Feasibility of Epidemiological Studies, 1995 (See summary in **Appendix 12**)

National Academy of Sciences, Report of Panel on Feasibility and Desirability of Performing Epidemiological Studies on U.S. Veterans of Hiroshima and Nagasaki, 1981

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Thaul et al., The Five Series Study: Mortality of Military Participants in U.S. Nuclear Weapons Tests, Medical Follow-up Agency, Institute of Medicine, National Academy of Sciences, 1999 (See summary in **Appendix 10e**)

VA Fact Sheet, VA Programs for Veterans Exposed to Radiation (**Appendix 1**)

VHA Handbook 1301.1, Ionizing Radiation Registry Program Procedures (**Appendix 2**)

Watanabe et al., Cancer Mortality Risk Among Military Participants of a 1958 Atmospheric Nuclear Weapons Test, American Journal of Public Health, April 1995, Volume 85, Number 4, pages 523-527 (See summary in **Appendix 10b**)

6. VETERANS STATIONED AT HANFORD AND OTHER NUCLEAR WEAPONS FACILITIES

The Manhattan Project to develop an atomic weapon during World War II was a colossal effort. Major facilities included Oak Ridge where uranium was enriched (by separating the more radioactive isotope U-235 from U-238), Hanford where plutonium was produced, and Los Alamos where many components of the atomic bomb were designed and tested. Active-duty military personnel as well as civilians participated in the Manhattan Project and were stationed at nuclear weapons facilities.

In addition to concerns about possible exposures to IR at the nuclear weapons facilities themselves, concerns have been expressed about health risks due to releases of radioactive materials into the air and water, especially from Hanford.

Dose information for service personnel stationed at or near Hanford and other nuclear weapons facilities generally has been unavailable although the Department of Energy recently has increased its efforts to address this problem.

No epidemiological studies specifically of veterans stationed at Hanford or other nuclear facilities are available.

Because of statutory restrictions, veterans who served at Hanford or other nuclear weapons facilities are not eligible for the special VA medical programs available to veterans who participated in the occupation of Hiroshima or Nagasaki or atmospheric nuclear weapons tests. [However they could be offered evaluations comparable to Ionizing Radiation Registry Examinations if they have other eligibility for VA care.]

KEY REFERENCES ON NUCLEAR WEAPONS FACILITIES

Battelle Pacific Northwest Laboratories, Columbia River Pathway Dosimetry Report, 1944-1992, July 1994 and Atmospheric Pathway Dosimetry Report. 1944-1992, October 1994

Purcell, J., The Best-Kept Secret, the Vanguard Press, 1963

Technical Steering Panel, Representative Hanford Radiation Dose Estimates, April 21, 1994

7. VETERANS EXPOSED TO NASOPHARYNGEAL (NP) RADIUM IRRADIATION

During the 1920s, a new technique was developed to treat hearing loss due to repeated ear infections. This therapy called nasopharyngeal (NP) radium irradiation involved inserting radium-tipped applicators through the nostrils to the throat and leaving them in place close to the adenoids for about 5 to 12 minutes. The radiation shrank lymphoid tissue adjacent to the openings of the Eustachian tubes thus unblocking them.

The treatments also was used to treat sinusitis, tonsillitis, asthma, bronchitis and repeated viral and bacterial infections. Treatments usually were performed on both sides and frequently were administered 3 times at 2-week intervals. An estimated 500,000 to 2 million civilians, mostly children, are estimated to have received these treatments.

During World War II and until about 1960, NP radium treatments were used to treat aerotitis media (barotrauma) in military personnel. Thousands of aircrew members, submariners, and divers were treated. Development of pressurized aircraft cabins and new treatments such as better antibiotics as well as concerns about radiation safety resulted in the discontinuation of NP radium irradiation.

The radiation doses from NP radium irradiation treatments were very dependent on the distance from the radium source. The following doses for an adult were estimated for a series of 3 treatments to each side of 8 minutes each using a 50-mgm radium source:

Tissue within a few centimeters of radium source – hundreds of rads; brain – 3 rads (range 0.7-16 rads); pituitary – 16 rads; salivary gland – 8.5 rads (range 3-17 rads); thyroid gland -1.4 rads.

Possible adverse health effects of NP radium irradiation

One major study found an increased risk of head and neck cancer in people who were treated when they were children. Another study, also mostly of individuals treated as children, did not find any statistically significant increase in head and neck cancers.

A study by the VA's Environmental Epidemiology Service of submariners given NP radium treatments found statistically significant increased mortality risk for all causes and circulatory diseases. An increased mortality risk of head and neck cancer also was found but was not statistically significant (see summary of journal article in **Appendix 13**).

Clinical recommendations from workshop on NP radium irradiation

A workshop on public health issues associated with NP radium treatments was held at Yale University in 1995. No screening tests for asymptomatic individuals who had been treated with NP radium irradiation were recommended.

VA programs for veterans treated with NP radium irradiation in service

(see Fact Sheet in **Appendix 4a** and VHA Directive in **Appendix 4b**).

Eligibility to participate in the VA Ionizing Radiation Registry (IRR) Examination program regardless of their enrollment status. Examination by an ENT specialist and additional studies, such as biopsies will be performed if clinically indicated.

Eligibility for treatment of any head or neck cancer which may be associated with NP radium irradiation treatments, regardless of their enrollment priority group or enrollment status.

KEY REFERENCES ON NP RADIUM IRRADIATION

Kang et al., A Mortality Follow-up Study of WWII Submariners Who Received Nasopharyngeal Radium Irradiation Treatment, American Journal of Industrial Medicine Volume 38, 2000, pages 441-446 (see summary in **Appendix 13**)

Sandler et al., Neoplasms Following Childhood Radium Irradiation of the Nasopharynx, JNCI, Volume 64, 1982, pages 3-8

Stolwijk and Saftlas, The Public Health Response to Nasopharyngeal Radium Irradiation: A Workshop, Otolaryngol. Head Neck Surg, Volume 115, 1996, pages 387-446

VA Fact Sheet, Nasopharyngeal Radium Therapy (see **Appendix 4a**)

VHA Directive 98-059, Health Services for Veterans Treated with Nasopharyngeal (NP) Radium During Active Military, Naval, or Air Service (see **Appendix 4b**)

Verduijn et al., Mortality After Nasopharyngeal Radium Irradiation for Eustachian Tube Dysfunction, Ann Otol Rhinol Laryngol, Volume 98, 1989, pages 839-844

8. VETERANS EXPOSED TO DEPLETED URANIUM (DU)

Depleted uranium (DU) is a by-product of the uranium enrichment process by which U-235 is purified for use in nuclear power plants and nuclear weapons. During this process, both U-234 and U-235 are removed. Since U-234 and U-235 are the more radioactive of the natural uranium isotopes, DU is about half as radioactive as natural uranium (i.e., DU has about half the number of disintegrations per second per gram). Removal of U-234 has the greatest impact on the radioactivity of DU for although U-234 makes up only a very small portion (.0058%) of natural uranium, its radioactivity is extremely high (6200 µCi/g) when compared to the other isotopes (2.2 µCi/g for U-235 and 0.33 µCi/g for U-238). U-234, therefore, contributes approximately 0.36 µCi/g or almost half of the radioactivity of natural uranium. In DU, the concentration of U-234 is 0.001 %, thus diminishing its contribution to the total radioactivity of DU to approximately 0.062 µCi/g or l6%. (Refer to the Physician Information Packet (2000) in **Appendix 15** for chart of contributions of individual isotopes to radioactivity of uranium and DU.)

DU is primarily a hazard if internalized due to its alpha particle emission. The toxicity of DU is related more to its chemical properties as a heavy metal than its radioactivity.

Because of DU's high density and other properties, it is used by the military forces in armor to protect tanks and in munitions to enhance penetration and destructive effects. During the Gulf War (GW), DU-containing weapons were used on a very large scale for the first time and were utilized only by the U.S. and British forces. U.S. service personnel potentially exposed to DU include "friendly fire" casualties with retained fragments or wound contamination, those who entered vehicles that had been damaged by DU munitions, individuals who cleaned or salvaged DU-damaged vehicles, and personnel who breathed smoke or dust containing DU particles.

DoD has estimated that external exposure to DU by service personnel in the GW would have been unlikely to exceed the applicable NRC occupational dose limits.

The highest internal radiation dose found in veterans who were tested by whole-body counting as part of the DU Follow-up Program at the Baltimore VA Medical Center was slightly over the NRC's annual allowance for the general public of 0.1 rem per year.

Health effects of DU

Since DU was not used in weapons prior to the GW and since DU exposure in the GW was different in various ways from other forms of exposure to uranium (e.g., in uranium miners and millers), relatively little is known about DU's long-term health effects. Therefore a DU Follow-up Program (see below) was established in 1993 at the Baltimore VA Medical Center to provide clinical surveillance to veterans and active-duty personnel who had significant exposure to DU (primarily those with retained DU fragments.)

Significant findings of the Baltimore DU Follow-up Program include the following:

- Elevated uranium excretion in the urine (primarily in those with retained DU fragments) but no evidence of renal damage or impairment of renal function;
- Urinary uranium excretion appears to be a more sensitive screening test than external body/whole-body counting for significant DU exposure;
- Elevated urine uranium levels were related to poorer performance on some computerized neuropsychological tests; new data in press show this effect is dampening;
- Uranium was present in the semen of several veterans with elevated urine uranium levels. These are preliminary findings that need further exploration. There is no evidence of birth defects in the over 30 children born to these veterans;
- Elevated urine uranium levels were related to higher prolactin levels, most of which were within the upper bounds of the normal range in the 1997 results, but the 1999 data did not find that.

See **Appendix 14** for a copy of a paper by McDiarmid et al. See **Appendix 15** for DU; Information for Clinicians from the Baltimore VAMC for additional information.

The Baltimore VA Medical Center DU program also is providing direction to an expanded DU screening program (see below). Elevated urine uranium values were found to be unlikely in the absence of retained DU metal fragments. It was felt that there was little likelihood that those with normal urine uranium levels when tested would develop any uranium-related toxicity. A committee of the Institute of Medicine (IOM), National Academy of Sciences, reviewed the possible effects of DU exposure. It concluded that there was limited/suggestive evidence of no association between exposure to uranium at cumulative internal dose levels lower than 20 rem or 25 rads and lung cancer. Also, the committee found limited/suggestive evidence of no association between exposure to uranium and clinically significant renal dysfunction. The IOM committee found that there was inadequate/insufficient evidence to determine whether or not associations existed between uranium exposure and a number of other cancers and diseases.

Special VA programs for DU-exposed veterans

Veterans exposed to DU in the GW are eligible to participate in the VA's Gulf War Registry Examination program, which includes DU screening (see below). GW veterans also have special eligibility (Priority Level 6) to enroll in VA health care for treatment of conditions possibly related to service in the Persian Gulf.

DU Screening Program – In 1998 the VA and DoD established a screening program for GW veterans whom DoD has identified as potentially having significant DU exposure and other GW veterans who are concerned about possible DU exposure. See **Appendix 3** for a copy of VHA Directive 98-032 Evaluation Protocol for Gulf War Veterans with Potential Exposure to Depleted Uranium (DU).

DoD has classified exposures to DU in the GW into 3 levels:

- Level I includes service personnel in or on a vehicle at the time it was penetrated by a DU munition and rescuers who entered US vehicles immediately afterwards. DoD estimates that less than 200 U.S. personnel are in Level I.

- Level II includes personnel who worked with DU-contaminated vehicles or other systems (including members of the 144th Service and Supply Company of the NJ National Guard) or were involved in the clean-up after a fire in Camp Doha's North Compound. DoD estimates that there were about 800 U.S. personnel in Level II.

- Level III includes personnel exposed to smoke containing DU or who entered DU-contaminated vehicles. DoD estimates that Level III includes at least hundreds of U.S. personnel who were exposed to smoke at Camp Doha.

[Other personnel not in one of these three categories presumably were at less risk for significant DU exposure.]

The screening program includes (1) a GW registry examination (if not already performed), (2) a detailed questionnaire about possible DU exposures in the GW, and (3) a 24 hour urine collection for uranium determination.

The Baltimore DU Follow-up Program (see below) provides guidance to other facilities regarding DU issues and is coordinating urine uranium testing and interpretation. Isotopic uranium analysis may be able to separate those with excretion of high levels of natural uranium (e.g., from living in an area with high uranium concentrations in the soil and water) from those exposed to DU.

DU Follow-up Program – As noted above, a DU Follow-up Program has been established at the Baltimore VA Medical Center. Initially about 35 veterans mostly with retained DU fragments were invited to participate in this clinical surveillance program.

Recently additional GW veterans who were felt to have similar opportunities for significant DU exposure have been added and a total of 51 individuals were evaluated as inpatients at the Baltimore VAMC during 1999. It is expected that the VA will offer long-term follow-up surveillance to individuals with significant amounts of internalized DU.

KEY REFERENCES RELATING TO DU

Baltimore VA Medical Center DU: Information for Clinicians (**Appendix 15**)

Environmental Exposure Report Depleted Uranium in the Gulf (II), DOD Office of the Special Assistant for Gulf War Illnesses, December 2000, **http://www.gulflink.osd.mil/du_ii/**

Hooper et al., Elevated urine uranium excretion by soldiers with retained uranium shrapnel. Health Physics, Volume 77, Number 5, pages 512-519, 1999

Institute of Medicine, National Academy of Sciences, Gulf War and Health Volume 1. Depleted Uranium, Sarin, Pyridostigmine Bromide, Vaccines, 2000

McDiarmid et al., Health effects of depleted uranium on exposed Gulf War veterans. Environmental Research, Volume 82, pages 168-180, 2000. (see **Appendix 14**)

McDiarmid et al., Urinary Uranium Concentrations in an Enlarged Gulf War Veteran Cohort, Health Physics, Volume 80, Number 3, pages 270-273, 2001

McDiarmid, Melissa, Depleted Uranium and Public Health, British Medical Journal Volume 322, Number 7279, pages 123-124, January 20, 2001

VHA Directive 98-032 Evaluation Protocol for Gulf War Veterans with Potential Exposure to Depleted Uranium (DU), July 9, 1998 (see **Appendix 3**)

9. CONCERNS ABOUT EARLY RADIATION-RELATED RESEARCH

In 1993, the former Secretary of the Department of Energy, Hazel O'Leary, disclosed that some early radiation experiments may not have conformed to current policies and procedures for written informed consent and protection of human subjects. Subsequently a cabinet level Interagency Work Group (IWG) and a presidential Advisory Committee on Human Radiation Experiments (ACHRE) were established to investigate these issues further and consider corrective action.

Many veterans and family members were concerned about these disclosures and the VA received over 1700 radiation inquiries. The former VA Secretary, Jesse Brown, stated strongly that the VA would carry out any necessary actions to protect VA patients who had participated in such experiments and the VA cooperated with efforts of the IWG and ACHRE.

Directives were issued to obtain information about early VA human research projects involving radiation, radioisotopes and radiation therapy performed between 1947 (when the first VA radioisotope programs were established) until 1980 (when policies regarding informed consent and protection of human subjects were firmly in place).

Attention was focused on early VA projects for which at least some names of research subjects were known since these would be the ones for which follow-up actions to benefit veterans or their families might be possible. Based on the responses from VA medical centers (VAMCs) to the survey questionnaire and other information, 53 projects at 17 VAMCs were reviewed by an expert committee including specialists in nuclear medicine, health physics/radiation safety, radiation oncology, and radiation dosimetry.

Analysis of this group of early VA experiments suggests that there was no widespread exposure of veterans to excessive doses of ionizing radiation. Almost all the research was conducted exclusively for medical purposes to improve diagnosis or treatment of diseases and primarily involved tracer amounts of radiation. Of the early VA research programs reviewed, only one project (to study strontium which is present in nuclear fallout) appears to have been done primarily for military purposes.

Most of the radiation hotline and similar inquiries received by the VA were related to ionizing radiation exposure during military service. Inquiries that were related to possible radiation research or treatment at VAMCs were referred to the appropriate VA facilities for investigation and response. Most such inquiries were found to involve standard diagnostic or treatment procedures, not research using radiation or any other experimental studies.

Some early VA records referred to a “confidential” Atomic Medicine Division. Reviews indicated that such a division was discussed as a means to deal with issues such as adjudication of radiation related compensation claims but was never activated. The VA did establish an office to oversee development of Nuclear Medicine programs and the VA played a leadership role in creating this medical specialty.

The ACHRE reviewed selected VA and other research projects and did not recommend any medical notification or follow-up programs for research subjects or their descendents. See **Appendix 7** for summary of pertinent sections of the ACHRE final report.

The VA is continuing to receive a limited number of additional inquiries about radiation “experiments” or other exposures at its facilities and these are referred to the appropriate medical center for investigation and response.

KEY REFERENCE ON EARLY RADIATION RESEARCH

Advisory Committee on Human Radiation Research, Final Report 1995 (See summary of pertinent sections in **Appendix 7**)

10. OTHER VETERANS WHO MAY HAVE BEEN EXPOSED TO IR IN SERVICE

Other veterans also may have been exposed to IR during military service (e.g., personnel in the Navy who served in nuclear submarines and other nuclear ships and shipyards, personnel who were involved with nuclear weapons handling and maintenance, personnel involved in clean-ups after accidents involving nuclear weapons, military medical personnel, etc.).

Radiation doses are sometimes not available. In general most recorded or estimated doses for "occupationally exposed" personnel have not exceeded the relevant exposure limits then in effect.

Other personnel may have been exposed as a result of diagnostic X-rays or radiation therapy during military service.

A study of U.S. nuclear submariners found a mortality rate for leukemia that was equivalent to that of U.S. males. Mortality rates for other malignant neoplasms also were not significantly elevated.

Currently there are no special programs or special eligibility for VA care for such veterans. They currently are not eligible for the VA's Ionizing Radiation Registry Examination program [but could be offered comparable evaluations if they have other eligibility for VA care] and do not have special eligibility for enrollment.

KEY REFERENCE ON OTHER EXPOSURE TO IR

Charpentier et al., The mortality of US nuclear submariners, 1969-1982, Journal of Occupational Medicine, Volume 35, Number 5, May 1993, pages 501-509

11. POSSIBLE FUTURE EXPOSURE OF VETERANS TO IR

At the request of the U.S. Army, the Medical Follow-up Agency of the National Academy of Sciences provided recommendations on radiation protection and safety of military personnel. Issues addressed included consideration of long-term health effects, consideration of the risks and benefits of the contemplated military action and competing risks to justify exposure, minimize dose, in peacetime and non-emergency situations provide the same level of protection accorded civilians, communicate risk, provide individual dosimeters, and maintain records of exposure.

KEY REFERENCE ON FUTURE EXPOSURE

Institute of Medicine, Potential Radiation Exposure in Military Operations, 1999

12. EXPOSURE OF VETERANS TO NON-IONIZING RADATION

Veterans are also concerned about exposure to non-ionizing radiation (NIR) including radar and other forms of microwaves.

Personal devices to measure individual exposure to NIR generally are not available, unlike the case with IR and film badges and TLDs.

A study of Navy personnel from the Korean War period did not identify adverse health effects that could be attributed to microwave/radar exposure. A follow-up study by the National Cancer Institute and the Medical Follow-up Agency of the National Academy of Sciences currently is being carried out.

An Air Force study found a small association between exposure to ELF and RF/microwave EMF and brain tumor risk.

KEY REFERENCES RELATING TO NON-IONIZING RADIATION

Robinette et al., Effects upon health of occupational exposure to microwave radiation (radar), American Journal of Epidemiology, Volume 112, 1980, pages 39-53.

Grayson, J., Radiation exposure socioeconomic status, and brain tumor risk in the US Air Force: a nested case-control study, American Journal of Epidemiology, Volume 143, 1996, pages 480-486.

13. ADJUDICATION OF VETERANS' RADIATION CLAIMS

"Atomic veterans" may qualify for compensation payments for diseases possibly due to IR under two programs.

Statutory Program*

If an atomic veteran develops one of the diseases shown below and meets other requirements, the condition is presumed by law/statute to be related to exposure to IR in service.

Statutory List

All forms of leukemia except chronic lymphocytic leukemia
Cancer of the thyroid
Cancer of the breast
Cancer of the pharynx
Cancer of the esophagus
Cancer of the stomach
Cancer of the small intestine
Cancer of the pancreas
Cancer of the bile ducts
Cancer of the gall bladder
Cancer of the salivary gland
Cancer of the urinary tract (kidneys, renal pelvis, ureter, urinary bladder and urethra)
Lymphomas (except Hodgkin's disease)
Multiple myeloma
Primary liver cancer

Recently added: Bronchioloalveolar cancer of the lung

For "presumptive" cases, the Defense Threat Reduction Agency (DTRA) of the Department of Defense (formerly the Defense Special Weapons Agency and the Defense Nuclear Agency) is responsible for demonstrating from record sources that the veteran participated in the occupation of Hiroshima or Nagasaki or in an atmospheric nuclear weapons test.

* The VA recently has proposed to add cancers of the bone, brain, colon, lung and ovary to the list of conditions presumed to be service connected for atomic veterans and to expand the definition of "radiation risk activities."

Regulatory Program

If an atomic veteran develops one of the diseases shown below and meets other requirements, compensation may be provided according to VA regulations. This list of diseases and other requirements are established by the Secretary of Veterans Affairs rather than being established by law/statute.

Regulatory List

All cancers
Posterior subcapsular cataracts
Non-malignant thyroid nodular disease
Parathyroid adenoma
Tumors of the brain and central nervous system

Note: VA also will consider evidence that diseases other than those specified in regulation may be caused by radiation exposure.

For adjudicating claims under the regulatory process, the following factors are considered:

(1) The probable dose, in terms of dose type, rate and duration as a factor in inducing the disease, taking into account any known limitations in the dosimetry devices employed in its measurement or the methodologies employed in its estimation;

(2) The relative sensitivity of the involved tissue to induction, by ionizing radiation, of the specific pathology;

(3) The veteran's gender and pertinent family history;

(4) The veteran's age at time of exposure;

(5) The time-lapse between exposure and onset of the disease; and

(6) The extent to which exposure to radiation, or other carcinogens, outside of service may have contributed to development of the disease. (Reference: Title 38 US Code, section 3.311).

For "regulatory" cases, the DTRA is responsible for documenting the atomic veteran's participation as above and for providing a radiation dose estimate. Atomic veterans who have questions about their IR doses may call the DTRA toll-free at 1-800-462-3683.

Various sources of information are used to determine if it is likely that the veteran's disease should be attributed to exposure to IR in service. These include screening doses developed by the Committee on Interagency Radiation Research and Policy Coordination (CIRRPC) based on NIH radioepidemiological tables [see **Appendix 16**], reports from the Committee on Biological Effects of Ionizing Radiation (BEIR) of the National Research Council, major textbooks, etc.

Currently the VA and NIH are cooperatively sponsoring a project to update and expand radioepidemiological tables in the form of a computer software program designated as the Interactive Radio Epidemiological Program (IREP) to assist in adjudication of IR claims.

Other veterans exposed to IR in service (e.g., those stationed at nuclear weapons facilities, nuclear submariners, individuals treated with NP radium in service, military medical personnel, etc.) are not eligible for the statutory "presumptions" so their claims are adjudicated under the "regulatory" provisions. Doses of IR for these veterans may be sought in the veteran's service records (e.g., DD 1141 forms), service medical records (e.g., information about NP radium treatments), radiation dosimetry offices of the various military services, Department of Energy (for veterans stationed at nuclear weapons facilities), etc. See **Appendix 5** for points of contact for requesting dose information.

Veterans may also submit claims with appropriate medical or scientific justification that diseases other than those on the VA's statutory and regulatory lists were caused by radiation. Such claims will be reviewed with consideration of doses and other factors.

According to VA regulations, a veteran who disagrees with the dose estimate provided by the Department of Defense can obtain at his or her expense an independent estimate from a credible source. If the independent dose estimate furnished by the claimants expert is at least double the government estimate, the case may be referred to an independent expert for preparation of a separate radiation dose.

Veterans who have questions about or wish to file a compensation claim may call the VA Regional Office for their area toll-free at 1-800-827-1000.

Some veterans also may be eligible for compensation under the Radiation Exposure Compensation Act (RECA). The RECA is administered by the Department of Justice. Inquiries may be addressed to:

Gerald Fischer
Assistant Director, Radiation Exposure Compensation Program
U.S. Department of Justice
Ben Franklin Station
P.O. Box 146
Washington, D.C. 20044-0146
Telephone 1-800-729-7327

KEY REFERENCES ON RADIATION COMPENSATION CLAIMS

Title 38 Code of Federal Regulations Sections 3.309 and 3.311

Committee on Interagency Radiation Research and Policy Coordination (CIRRPC), Science Panel Report Number 6, Use of Probability of Causation by the Veterans Administration in the Adjudication of Claims of Injury Due to Exposure to Ionizing Radiation, 1988 (see excerpt in **Appendix 16**).

14. RADIATION SAFETY IN VA MEDICAL CENTERS (BY LYNN McGUIRE)

The Nuclear Regulatory Commission (NRC) requires that a VA medical center possess a license for use of radioactive materials, and an inspection is performed periodically by the NRC to assure that the material is being used safely. Other federal agencies, such as the Occupational Safety and Health Administration, Environmental Protection Agency, and the Food and Drug Administration, have additional regulatory authority over some phases of use of radioactive materials, research uses of radiopharmaceuticals and x-ray machines.

The day-to-day use of radiation sources in the medical center is monitored by local safety committees composed of individuals knowledgeable in the safe use of radiation. These committees require that regulations established by national and international radiation standard-setting groups are adhered to. In addition, a radiation safety officer is appointed as the delegated authority of the committees to assure radiation safety. National oversight of radiation safety in the Veterans Health Administration (VHA) is performed by the National Radiation Safety Committee (NRSC). The NRSC is composed of VHA senior officials and representatives from field facilities.

15. RESEARCH IN VA FACILITIES INVOLVING RADIATION

A complex system of regulations and committees are mandated by the VA, Food and Drug Administration, Nuclear Regulatory Commission, and other agencies to oversee VA research involving ionizing radiation.

Depending on the type of proposed radiation-related research, approval may be required from the following committees:

- Research and Development Committee;
- Radiation Safety Committee;
- Human Experimentation Committee of the Institutional Review Board; and
- Radioactive Drug Research Committee.

16. VA MEDICAL EMERGENCY RADIOLOGICAL RESPONSE TEAM (MERRT)

The VA MERRT is intended to assist in responding to various types of radiological emergencies. Its roles include providing technical advice, radiological monitoring, and medical care and decontamination expertise. As of 11/99 membership included radiologists and health physicists.

APPENDICES

APPENDIX 1

Department of Veterans Affairs

Office of Media Relations
Washington, D.C. 20420
(202) 273-5700
www.va.gov

Fact Sheet

November 2000

VA PROGRAMS FOR VETERANS EXPOSED TO RADIATION

VA provides special priority for health-care services to veterans who participated in atmospheric nuclear tests or the American occupation of Hiroshima and Nagasaki, Japan and to certain veterans who were POWs there. In addition, these "atomic veterans" are eligible to take part in the VA ionizing radiation registry examination program. VA also provides compensation to certain veterans and their survivors if the veteran has a disability that is associated with these events.

Radiation Statistics

About 195,000 service members participated in the post-World War II occupation of Hiroshima and Nagasaki, Japan, or were prisoners of war there. Over 95 percent of them received doses below 0.1 rem, a standard measurement of radiation exposure. Only those Nagasaki occupation forces who regularly entered the Nishiyama area had the potential to receive doses up to 1 rem.

In addition, approximately 210,000 service members took part in United States atmospheric nuclear tests between 1945 and 1962 in the United States, the Pacific and the Atlantic. Fewer than one percent of them received doses greater than 5 rem per year, the current federal occupational radiation dose limit. The average radiation dose received by participants was about 0.6 rem.

The Defense Threat Reduction Agency's Nuclear Test Personnel Review program has maintained a database of participants in U.S. atmospheric nuclear test activities since 1978.

Determination of Service-Connected Diseases

VA provides disability compensation for radiogenic diseases under two programs specific to radiation-exposed veterans and their survivors:

Statutory List. Veterans who participated in nuclear tests by the U.S. or other countries, or who served with the U.S. occupation forces in Hiroshima or Nagasaki, Japan, between August 1945 and July 1946, or who were prisoners of war in Japan during this period, are eligible for compensation for cancers specified in federal law. The 16 types of cancer covered by these laws are: all forms of leukemia except chronic lymphocytic leukemia; cancer of the thyroid, breast, pharynx, esophagus, stomach, small intestine, pancreas, bile ducts, gall bladder, salivary gland and urinary tract (kidneys, renal pelvis, ureter, urinary bladder and urethra); lymphomas (except Hodgkin's disease); multiple myeloma; primary liver cancer; and bronchio-alveolar carcinoma (a rare lung cancer).

Regulatory List. For radiogenic diseases not covered in the statutory list, regulations provide for consideration of disability compensation claims from veterans exposed to radiation during military service. Under the regulations, additional factors must be considered to determine service-connection, including amount of radiation exposure, duration of exposure and elapsed time between exposure and onset of disease. VA regulations define all cancers as potentially radiogenic, as well as certain other non-malignant conditions: posterior subcapsular cataracts; non-malignant thyroid nodular disease; parathyroid adenoma; and tumors of the brain and central nervous system.

Claims for compensation may be filed at a VA regional office. Veterans or their survivors can reach a regional office by calling 1-800-827-1000. The Defense Department maintains a help line at 1-800-462-3683 to provide veterans information about their test participation.

Rates of Disability Compensation

Rates of compensation depend upon the degree of disability and follow a payment schedule that applies to all veterans. Current rates at increments of 10 percent disability are listed in VA's handbook, "Federal Benefits for Veterans and Dependents," and are available on the Web by following the compensation link at **http://www.va.gov/**. Additional amounts may be awarded for severe disabilities.

For deaths in 1993 and after, compensation to survivors is paid at a flat rate regardless of the deceased veteran's rank in the service. An additional amount may be paid if the veteran had been rated 100-percent disabled for service-connected disabilities for at least eight years prior to death and had been married to the surviving spouse during the same period. Additional amounts also may be payable to the surviving spouse for dependent minor children.

Ionizing Radiation Registry Program

In addition to special eligibility to enroll for VA health care for radiation-related conditions, atomic veterans are eligible to participate in VA's Ionizing Radiation Registry examination. Under this program, VA will perform a complete physical examination for each veteran who requests it if the veteran participated in atmospheric nuclear weapons testing, or if he or she served with the U.S. occupation forces in Hiroshima or Nagasaki or was a POW there. Veterans need not be enrolled for general VA care to be eligible for the Ionizing Radiation Registry. As of the beginning of 2000, nearly 22,000 veterans had received this special examination.

Medical Care (FY 2001)

VA has announced that its fiscal year 2001 appropriations are expected to be sufficient to provide medical services for any veteran who comes to VA for care, including atomic veterans. Veterans are encouraged to complete a brief form to apply for enrollment in the VA health care system.

This can be requested toll-free from the VA at 1-877-222-VETS. Veterans are encouraged to establish a record and apply for enrollment before they become ill, which will simplify access at the time of illness and will also aid VA in its planning.

If, in the future, appropriations are insufficient to meet projected demand, VA will use a priority system established in Public Law 104-262, "The Veterans Health Reform Act," to allocate health care resources by using seven priority groups. Group 1 is the highest-eligibility group, while Group 7 is the lowest.

According to the law, atomic veterans only seeking care for conditions associated with their exposure to ionizing radiation are included in Priority Group 6. If appropriations are insufficient to care for all honorably discharged veterans and the Category 6 ranking is a veteran's only basis for eligibility, he or she would be eligible only for care of exposure-related conditions. Care for these conditions is provided without regard to the veteran's age, service-connected status or ability to defray the cost of medical care, and no co-payment by the veteran is required. In other words, even if an eligible veteran has never filed a compensation claim or if the claim has been denied, the veteran can still receive free health care for conditions recognized by VA as potentially caused by radiation.

If a veteran with a radiation-related claim has been granted service-connection with compensation, his or her priority would be even higher – in Groups 1 to 3 – depending on the severity of the illness. However, in fiscal 2001, VA expects that all groups will receive care as was the case in fiscal year 2000.

More information about VA health care eligibility and enrollment is available on the Internet at **http://www.va.gov/pubaff/enroll.htm**.

APPENDIX 2

Department of Veterans Affairs
Veterans Health Administration
Washington, DC 20420

VHA HANDBOOK 1301.1
Transmittal Sheet
August 13, 1999

IONIZING RADIATION REGISTRY PROGRAM PROCEDURES

1. **REASON FOR ISSUE**: This Veterans Health Administration (VHA) Handbook establishes procedures for the Department of Veterans Affairs (VA), VHA, Environmental Agents Service (EAS), Ionizing Radiation Registry Program. It implements changes in health services for veterans mandated by Public Laws 104-262 and 105-368.

2. **SUMMARY OF MAJOR CHANGES**: This Handbook constitutes a total revision of VHA Manual M-10, "Environmental Medicine," Part II, "Ionizing Radiation Program," Chapters 1 and 2. The principal changes as mandated by Public Law 104-262 involve eligibility for care and adds conditions which VA now recognizes as being potentially radiogenic; Public Law 105-368 authorizes care and services, limited to examinations and treatment of head and neck cancers for veterans who had received nasopharyngeal radium treatments during active military, naval, or air service.

3. **RELATED ISSUES:** VHA Directive 1301 and VHA Directive 98-059, December 23, 1998.

4. **RESPONSIBLE OFFICIALS**: The Program Chief for Clinical Matters, Office of Public Health and Environmental Hazards (13), is responsible for the contents of this VHA Handbook. Questions may be referred to that individual at VHA Headquarters. ***NOTE:*** *Questions relating to eligibility for VA care, including enrollment should be directed to the eligibility staff at your facility.*

5. **RESCISSIONS**: This VHA Handbook rescinds Manual M-10, "Environmental Medicine," Part II, "Ionizing Radiation Program," Chapters 1 and 2, dated March 30, 1992.

6. **RECERTIFICATION**: This document is scheduled for re-certification on/before the last working day of August 2004.

Thomas L. Garthwaite, M.D.
Acting Under Secretary for Health

Distribution: **RPC: 0005**
FD
Printing Date: 8/99

APPENDIX 2

CONTENTS
IONIZING RADIATION REGISTRY PROGRAM PROCEDURES

Appendices

IONIZING RADIATION REGISTRY PROGRAM PROCEDURES

1. PURPOSE

This Veterans Health Administration (VHA) Handbook sets forth clinical and administrative policies related to the maintenance of the VHA Ionizing Radiation Registry (IRR) program of physical examinations for eligible, concerned veterans.

2. AUTHORITY

a. Public Law 99-576, "Veterans Benefits Improvement and Health Care Authorization Act of 1986," enacted October 28, 1986, required the Secretary of the Department of Veterans Affairs (VA) to establish and maintain an IRR of veterans exposed to radiation under conditions described in Title 38 United States Code (U.S.C.) § 1710(e)(1)(B). These conditions include:

(1) On site participation in a test involving the atmospheric detonation of a nuclear device (between 1945 and 1962), (whether or not the testing nation was the United States);

(2) Participation in the occupation of Hiroshima or Nagasaki from August 6, 1945, through July 1, 1946; or

(3) Internment as a Prisoner of War (POW) in Japan during World War II which the Secretary of Veteran Affairs, henceforth referred to as the Secretary, determines resulted in an opportunity for exposure to ionizing radiation comparable to that of veterans involved in the occupation of Hiroshima or Nagasaki. ***NOTE:*** *See 38 U.S.C. § 1710(e)(4)(B), referencing 38 U.S.C. § 1112(c)(3).*

b. Section 901 of Public Law 105-368, "Veterans Programs Enhancement Act," enacted November 11, 1998, codified at 38 U.S.C. § 1720E, states in part, that the Secretary may provide a medical examination, hospital care, medical services, and nursing home care, which the Secretary determines is needed for the treatment of any cancer of the head or neck which the Secretary finds may be associated with the veteran's receipt of Nasopharyngeal (NP) radium irradiation treatments while in the active military, naval or air service.

3. SCOPE

a. Registry examinations will be provided to eligible veterans who may have been exposed to a radiation-risk activity under the conditions described in this Handbook. In the absence of evidence to the contrary, a veteran's assertion of exposure at a nuclear device testing site (the Pacific Islands, e.g., Bikini, NM, NV, etc.) or in Hiroshima and/or Nagasaki, Japan, will be accepted.

b. Medical examinations may be provided to veterans who have received NP radium irradiation treatments while in the active military, naval or air service, and are experiencing head or neck complaints or who are concerned about possible adverse effects of their NP radium treatments.

(1) To be eligible for these medical examinations, a veteran must have:

(a) Documentation of NP radium treatment in active military, naval or air service;

(b) Served as an aviator in the active military, naval or air service before the end of the Korean conflict; or

(c) Undergone submarine training in active naval service before January 1, 1965.

NOTE: *Eligible veterans do not have to be enrolled in VA care to receive IRR examinations and co-payments are not required.*

4. DESCRIPTION OF SERVICES

The registry examination protocol for registry examinations authorized under conditions described in 38 U.S.C. 1710 (e) (1) (B) and medical examinations authorized for veterans who received NP treatments, authorized under conditions described in 38 U.S.C. 1720E,
is described in paragraph 11 of this Handbook. Congress made it clear that 38 U.S.C. Section 1710 (e) (1) (B) and 1720E provide for healthcare only and that a determination that the veteran is eligible for such care does not constitute a basis for service-connection or in any way affect determination regarding service-connection.

5. ELIGIBILITY CRITERIA

VA will provide IRR examinations and medical examinations to veterans who may have been exposed to radiation-risk activity under conditions described in paragraph 2 of this Handbook.

a. The IRR will consist of physical examinations with access to supplemental data on compensation claims and radiation exposures from the Veterans Benefits Administration (VBA) and the Department of Defense's (DOD's) Defense Threat Reduction Agency (DTRA), (formerly the Defense Special Weapons Agency (DSWA) and the Defense Nuclear Agency (DNA). VA shall compile and consolidate all pertinent information maintained by relevant elements of VA or DOD. According to the DTRA, over 200,000 test participants have been identified as to their specific involvement and their recorded radiation exposure. Approximately an equal number of service personnel were involved in occupation duties at Hiroshima and/or Nagasaki.

b. The Environmental Epidemiology Service (EES) in conjunction with DTRA will share files, when deemed appropriate, to obtain updated information on each veteran in the IRR, i.e., radiation exposures, unit assignments, etc.

c. Eligible veterans applying for treatment in a VA medical center and/or outpatient clinic should be encouraged to undergo an ionizing radiation examination, if they have not previously done so. Under the new eligibility program, veterans requesting IRR examinations do not have to be enrolled in the VA's healthcare system.

d. Veterans should be advised that examination or treatment for radiation-related diseases does not constitute a formal claim for compensation. Although the results of an IRR examination may be used to support a compensation claim, the examination will not, in and of itself, be considered such a claim. Veterans who wish to submit a claim for conditions possibly related to radiation exposure should do so via the normal claims process at the nearest VA Regional Office of jurisdiction, or through a veterans benefits counselor physically located at VA health care facilities.

6. PROGRAM MANAGEMENT

NOTE: *The Registry Physician (RP), Registry Coordinator (RC), and health administration staff of each VA facility play a significant role in determining the perceptions Ionizing Radiation (IRAD) veterans have concerning the quality of VA health care service and of their individual treatment by VA health care providers.*

a. **RP**. An RP and one or more alternates will be designated by the facility Chief of Staff (COS). In order to keep abreast of current information and program activities, RPs and assistants should be familiar with various materials distributed by VHA Headquarters. All program officials should attend the periodic Environmental Agents Service (EAS)

conference calls from VHA Headquarters, and all RPs, with computer access, should contact VHA Headquarters, EAS to be enrolled in the electronic mail group in Microsoft (MS) Exchange identified as "Registry Physicians."

b. **RC**. The RC and alternate(s) will be designated by the facility Director's office. All RCs should attend the periodic EAS conference calls from VHA Headquarters, and all RCs, with computer access, should contact VHA Headquarters, EAS to be enrolled in the electronic mail group in MS Exchange identified as "Registry Coordinators."

c. **RP and RC Listings**. Separate listings of the RPs and RCs are maintained by EAS. In an effort to keep these listings current, facilities are requested to notify EAS of changes as they occur in status of the RPs and RCs at their respective facilities and/or satellite clinics. These listings will include the name, title, mail routing, and commercial telephone and FAX numbers with area code, and should be submitted, in writing, to EAS (131), Department of Veterans Affairs, 810 Vermont Avenue, NW, Washington, DC 20420.

7. RP RESPONSIBILITIES

The RP is responsible for the program's clinical management and will serve in an advisory capacity for the administrative management of the program. Major responsibilities include:

a. **Counseling.** The RP advises the veteran of all aspects of the IRR examination.

b. **Documenting the Physical Examination**. The RP must:

(1) Conduct and document the physical examination in the Consolidated Health Record (CHR).

(a) This examination involves the taking of a complete medical history to include information about:

1. Family;

2. Occupation;

3. Social activities noting tobacco, alcohol, and drug use; and

4. Psychosocial condition.

(b) If a veteran is subsequently diagnosed with a significant radiation-related health problem by a non-VA physician, the veteran is to be encouraged to contact the veteran's local VA medical center to include additional diagnoses in the CHR and IRR.

1. This new diagnosis must be submitted over the non-VA physician's signature on official letterhead.

2. A code sheet identified as, follow-up examination, Type C, will be completed with this diagnosis and forwarded to the Austin Automation Center (AAC) for inclusion in the IRR.

(2) Review and complete Part I of VA Form 10-0020A, Ionizing Radiation Code Sheet, if necessary. ***NOTE:*** *No edition of VA Form 10-0020A, earlier than July 1999 may be used.*

(3) Complete Part II of VA Form 10-0020A (see App. D).

(4) Review the records of every IRAD veteran examined to ensure that a complete physical examination was performed and documented.

(5) Personally discuss with each veteran the:

(a) Findings of the physical examination and completed diagnostic studies. ***NOTE:*** *The interview will be conducted in such a way as to encourage the veteran to discuss health concerns, as well as those of family members, as they relate to ionizing radiation exposure. This information will be documented in the veteran's CHR. Every effort should be made to maintain the veteran's current address in the veteran's health care records and in the Veterans Health Information Systems and Technology Architecture (VISTA) computerized information system.*

(b) Need for follow-up examination(s) either recommended by the RP or requested by the veteran.

c. **Preparing and Signing Follow-up Letter**. The RP will ensure that appropriate personalized follow-up letters, explaining the results of the examination and laboratory studies, have been signed and mailed to the veteran (see App. A).

(1) Follow-up letters will be mailed to the veteran within 2 weeks of the initial examination. The only exception to this timeframe will be when a consultation at a specialty clinic is requested as part of the initial examination process. This exception suspends, but does not remove, the requirement for the follow-up letter. The follow-up letter will be sent within 2 weeks after the consultation.

(2) A dated copy of the follow-up letter will be filed in the veteran's CHR. ***NOTE:*** *It is essential that this letter be written in language that can be easily understood by the veteran. Inappropriate wording could unduly alarm or confuse the veteran. A great deal of sensitivity and care should be exercised in the preparation of this correspondence.*

(3) The follow-up letter will explain that:

(a) If the veteran examined has no detectable medical problems, the follow-up letter should so indicate and suggest that the veteran contact the nearest VA health care facility if health problems appear later.

(b) If it is determined upon examination that the veteran does have medical problems, it is not necessary to specify the problems in the letter. The veteran is to be advised in the letter that the recent examination indicated a health condition and/or problem, which may require further examination and/or treatment.

(c) If the veteran requires medical treatment, the letter is to advise the veteran to apply for enrollment and provide the name of a contact person, including telephone number, within the facility. If the veteran is not eligible for treatment, the letter is to so advise and recommend that the veteran seek appropriate medical care elsewhere.

8. REGISTRY COORDINATOR RESPONSIBILITIES

The RC is responsible for the administrative management of the program, including:

a. **Scheduling of Appointments.** Every effort should be made to give veterans ionizing radiation examinations within 30 days of the request date.

b. **Monitoring Timeframe Compliance.** All of the following require timeframe compliance:

(1) **Follow-up Letters.** Mail to veteran within 2 weeks of initial registry examination.

(2) **Registry Examination Appointment.** Schedule within 30 days of request date.

(3) **VA Staff (RC and RP) Changes.** Advise VHA Headquarters (131) as they occur.

(4) **Registry Code Sheets (VA Form 10-0020A) for Initial and Follow-up Examinations** Mail to AAC by the 15th workday of the following month (see **App. D**).

(5) **Invalid Registry Code Sheets (VA Form 10-0020A).** Correct and mail to the AAC ten workdays following receipt from the AAC.

c. **Reviewing Records for Accuracy and Completion.** All required records, e.g., computerized or card file records, follow-up letters, transmittal forms, registry code sheets of veteran participants, and CHRs are to be completed and reviewed for accuracy.

d. **Data for Reporting Purposes.** Required registry data should be obtained from the veteran or family, entered on IRAD Code Sheets and submitted to the AAC for entry into the IRR dataset. The AAC will provide IRR data reports to VHA Headquarters based on VA facility input.

e. **Disseminating Information.** It is important that each veteran be fully advised of the IRR examination program. Facility staff is encouraged to fully communicate all aspects
of the IRR examination program by any appropriate means. The following suggestions might be considered:

(1) Provide each veteran reporting to the Outpatient and Admission areas with a handout describing the purpose of the examination and its limitations. The examining physician during the course of the physical examination can further clarify this, preferably prior to beginning the physical examination process.

(2) Provide each veteran with current Office of Public Affairs News Service Fact Sheets and display these in prominent areas (outpatient clinics, admission areas, etc.) to ensure availability to veterans and other interested individuals.

(3) The RC receives all IRAD related inquiries, and is responsible for communicating appropriate information.

(4) The RC posts and communicates the names, locations, and office telephone numbers of the RP and the RC to concerned VA facility staff. ***NOTE:*** *An appropriate method is the use of medical center memoranda providing registry policy and procedures and those responsible for carrying out these policies.*

f. **Maintaining a Computerized Record or Card File**. The RC must establish and maintain a computerized record (or alpha card file) of all registry participants. Each record prepared should include the veteran's:

(1) Full name,

(2) Address,

(3) Telephone number,

(4) Date of birth,

(5) Social Security Number (SSN),

(6) Service Number,

(7) Date of initial examination (including date of code sheet submission to AAC), and

(8) Date(s) of subsequent follow-up examination(s) to include date of code sheet submission to AAC.

g. **Completing Code Sheet**

(1) The RC completes Part I of VA Form 10-0020A, before the veteran is referred to the clinician for the examination (see App. D).

(2) To further ensure the form's completeness, the clinical examiner will review it and, if necessary, enter missing items at the veteran's direction. In addition, the RP will inquire whether any of the veteran's natural children or grandchildren have any birth defects "Y(es)," "N(o)," or "U(nknown)," in Item 15, describing these defects in Item 18 "Remarks" section of the code sheet and in the CHR. ***NOTE:*** *Refer to instructions in* ***Appendix D.***

(3) In the event the veteran applying for care, who claims exposure to IRAD does not wish to participate in the registry, a code sheet will be completed and retained in the veteran's CHR. ***NOTE:*** *Do not send it to AAC.* In the "Remarks" section, Item 18, indicate current date and note that the veteran did not want to participate in the registry.

(4) Establishing and updating the CHR. The RC will establish a medical record if one does not already exist. VA Form 10-1079, Emergency Medical Identification, should be affixed to the front of the record and the word "RADIATION" circled. Any veteran claiming exposure to IRAD and all veterans participating in the registry should have VA Form 10-1079 affixed to the front of the CHR. Completed original code sheets (VA Form 10-0020A), dated follow-up letters, all medical records of registry examinations, and laboratory and/or test results will be maintained in veteran's CHR.

9. INCARCERATED VETERANS

a. Circumstances under which incarcerated veterans may be accepted for treatment in VA facilities are limited. A veteran in the custody of penal authorities, or under criminal charges, does not forfeit any right to medical care by VA.

b. Incarcerated veterans may be accepted, if otherwise eligible, for medical care only when released by an authorized official under circumstances where there is no obligation placed on VA to exercise custodial restraint, or to ensure the return of the veteran to custody

upon completion of treatment.

c. VA will not provide outpatient treatment at a penal institution for an incarcerated veteran.

d. If a veteran is paroled from a penal institution for the purpose of receiving VA staff care, the penal institution will be informed that VA is under no obligation for:

(1) The custody of the veteran, or

(2) The administration of punishment to the veteran, and/or

(3) The return of the veteran to civil authorities either during or upon completion of treatment.

NOTE: *The clinic Director, or designee, will notify the civil authorities when treatment will be completed.*

e. VA will not routinely bill the Bureau of Prisons for the treatment of eligible veterans who are treated in VA facilities.

f. For purposes of entry into the IRR, VA medical facilities can provide assistance to penal authorities or institutions agreeable to conducting examinations to veterans. ***NOTE:*** *The VA will not reimburse the penal authorities when they conduct these IRR examinations.*

(1) Copies of directives, code sheets, etc., will be provided to penal institutions upon request.

(2) Penal authorities must be advised at the time of such requests that the results of the examination provided at their institutions must be returned to the VA medical facility of jurisdiction for inclusion, in the veteran's behalf, in VA's IRR.

(3) A recommendation can be made to the penal institution to retain a copy of the examination documents submitted to VA. Such documents should be maintained by penal authorities until release of the individual from the penal institution.

10. VETERANS WITH OTHER THAN HONORABLE DISCHARGES

The requirements of VHA Manual M-1, Part I, Chapter 4, apply to veterans with less than honorable discharges applying for IRR examinations.

11. CONDUCTING THE PHYSICAL EXAMINATION

a. It is essential that a complete medical history, physical examination, and interview be performed and documented on appropriate medical record standard forms, by/or under the direct supervision of the RP or alternate.

b. The person actually performing the physical examination will be identified with the signature and title Doctor of Osteopathy (D.O.), Doctor of Medicine (M.D.), Physician's Assistant (P.A.), Certified Nurse Practitioner (CNP), etc. Examination completed by other than a physician must be completed by medical personnel privileged to do physical examinations. A physician's countersignature (preferably the RP's) is required on all examinations completed by other than a physician.

c. When an IRAD examination is done as part of a compensation and pension examination, the physical examination will be done by/or under the direct supervision of the RP or alternate.

d. Special attention will be given to the following conditions which VA has recognized by statute or regulation as being associated with radiation exposure:

NOTE: *The International Classification of Diseases – Clinical Modification (Ninth Edition) (ICD-9-CM).*

DIAGNOSIS	ICD-9-CM (Reference Guides)
(1) Leukemia, Lymphoid (except chronic lymphatic leukemia)	204-204.9 (except 204.1)
(2) Leukemia, Myeloid	205
(3) Leukemia, Monocytic	206
(4) Leukemia, Hairy Cell	202.4
(5) Leukemia, other	207
(6) Leukemia, Unspecified cell type	208
(7) Thyroid Cancer	193

DIAGNOSIS	ICD-9-CM (Reference Guides)
(8) Breast Cancer	174-175
(9) Lung Cancer (malignant neoplasm of trachea, bronchus, and lung)	162
(10) Bone Cancer	170
(11) Primary Liver Cancer	155
(12) Skin Cancer	172-173
(13) Esophageal Cancer	150
(14) Stomach Cancer	151
(15) Colon Cancer	153
(16) Pancreatic Cancer	157
(17) Kidney Cancer	189.0
(18) Urinary Bladder Cancer	188
(19) Salivary Gland Cancer (malignant neoplasm of major salivary gland)	142.
(20) Multiple myeloma	203
(21) Posterior Subcapsular Cataracts	366.02
(22) Non-malignant Thyroid Nodular Disease	241, 226
(23) Ovarian Cancer	183
(24) Parathyroid Adenoma	227.1
(25) Tumors of the brain and central nervous system	191-192
(26) Lymphomas other than Hodgkins Disease	200,202.0, 202.1, 202.2, 202.8, 202.9
(27) Cancer of the Rectum	154.1

DIAGNOSIS	ICD-9-CM (Reference Guides)
(28) Cancer of the Small Intestine	152
(29) Cancer of the Pharynx	146, 147, 148, 149
(30) Cancer of the Bile Duct	156.1
(31) Cancer of the Gall Bladder	156.0
(32) Cancer of the Renal Pelves, Ureters and Urethra	189.1, 189.2, 189.3
(33) Cancer of the Prostate	185
(34) Other malignancy(ies), not listed in the preceding diagnoses. ***NOTE:*** *Other conditions may be recognized in the future.*	

e. In gathering medical history data, it is important to record the time of the onset of the veteran's:

(1) Symptoms or conditions,

(2) Intensity,

(3) Degree of physical incapacitation, and

(4) Details of any treatment received.

f. Each veteran will be given the following baseline laboratory studies:

(1) Chest X-ray (as determined to be medically necessary);

(2) Complete blood count;

(3) SMA-6, SMA-12, or equivalent blood chemistries and enzyme studies; and

(4) Urinalysis.

g. Appropriate additional diagnostic studies are to be performed and consultations obtained as indicated by the patient's symptoms and physical and laboratory findings.

h. Non-routine diagnostic studies, such as computed tomography or magnetic resonance imaging, should be performed only if medically indicated.

i. Laboratory test results are to be filed in the CHR.

12. REPORTING REQUIREMENTS

a. **Code Sheet Submission**

(1) Reports Control Number 10-0110, applies to this reporting requirement.

(2) A monthly submission of VA Form 10-0020A, will be made to the AAC by the 15th workday of the following month (see App. D).

(3) Medical data should NOT be attached to the submitted code sheets.

(4) One legible copy should be sent to AAC, and the original filed in the veteran's CHR.

(5) Code sheets should be alphabetized by veteran's last name.

(6) Two copies of VA Form 7252, Transmittal Form for Use in Shipment of Tabulating Data, will be used to transmit code sheets.

b. **Monthly Statistical Report**

(1) Submit statistical information using VA Form 7252 as indicated (see example in App. D).

(2) The "cumulative count" figure is the total number of veterans who have had registry examinations for the calendar year.

(3) Negative Reports. Negative reports are not required; i.e., if there were no exams or code sheets processed for the month.

c. **RP and RC Listings**. Separate listings of the RPs and RCs are maintained by the EAS. In an effort to keep these listings current, facilities are required to notify the EAS of any changes at their respective facilities and/or satellite clinics (refer to subpar 6c).

d. **Forms Acquisition**.

(1) Forms indicated in this manual may be obtained from the Forms and Publication Depot through local channels. ***NOTE:*** *VA Form 30-7252 has been changed to VA Form 7252. The form itself has not been revised.*

(2) Facilities can use either form when submitting reports. VA Form 10-0020A is available on the Intranet at **http://vaww.va.gov/forms/medical/searchlist.asp**.

13. RECORDS CONTROL AND RETENTION

a. **Records Control**

(1) Consolidated Health Record (CHR) will be established if one does not exist.

(2) A locator record will be created for the card file.

(3) A VA Form 10-1079, Emergency Medical Identification, sticker will be affixed to the front of the CHR and word "Radiation" circled.

(4) The code sheet will be prepared with one copy.

(a) The original and the laboratory test results, progress notes, etc., will be filed in the CHR, and

(b) A legible copy of the code sheet will be sent to the AAC in Austin, TX, for entry into the IRR master record.

b. **Records Retention**. IRAD examination documents become part of the patient's CHR, i.e., medical records, and are retained in accordance with VHA Records Control Schedule 10-1. This includes:

(1) VA Form 10-0020A,

(2) Progress notes,

(3) Laboratory reports,

(4) Patient locator cards,

(5) X-rays, and

(6) Any other documentation that may have been part of a radiation examination.

14. EDUCATION AND TRAINING

a. Current information on the status of the IRAD Program should be presented to VA medical center staff (e.g., at staff conferences or grand rounds), veterans organizations, and community groups. ***NOTE:*** *This is an excellent means of exchanging ideas in a continuing effort to update and provide quality management of the IRAD Program*

(1) Telephone Conferences with VA medical facilities are held periodically by EAS, VHA Headquarters. ***NOTE:*** *Minutes of these telephone conferences, research journal reprints, and other educational items such as current Office of Public Affairs News Service VA Fact Sheet on "VA Programs for Veterans Exposed to Radiation" and VA Fact Sheet on "Nasopharyngeal Radium Therapy" are distributed by EAS to all RPs and RCs.*

b. Education and training should ensure the successful accomplishment of the following goals:

(1) Communicate effectively with special program participants by understanding the individual needs of specific groups of veterans.

(2) Acquire an in-depth knowledge of the specific processes, designated responsibilities, and time standard requirements of the Ionizing Radiation Program.

SAMPLE IONIZING RADIATION FOLLOW-UP LETTER (MEDICAL PROBLEMS INDICATED)

(Date)
(Name/Address)

Dear _____:

We wish to acknowledge your recent participation in the Department of Veterans Affairs (VA) Ionizing Radiation Registry (IRR) Program. This effort should prove to be helpful in assisting us to serve you with the possible health problems that may have resulted from a radiation-risk activity during

a. active military service; OR
b. as a member of a reserve component of the Armed Forces during a period of active duty for training or inactive duty training; OR
c. active military service for those persons who received nasopharyngeal irradium treatments).

As discussed at the conclusion of your visit, results of your examination and laboratory tests showed certain problems (optional – these findings may be described in lay terms). In view of these findings, we have scheduled you for treatment of these health problems on (date). If for any reason you cannot keep this appointment, please call (phone number) at the earliest possible time to cancel and reschedule.

If you have any questions or concerns about your IRR examination, please contact the Registry Coordinator (phone number) for assistance.

Please remember that this examination does not automatically initiate a claim for VA benefits. If you wish to file a claim for compensation to establish service connection, please contact your nearest VA Regional Office. In your area, the Regional Office is located at (address). Their telephone number is (phone number). Compensation claims need not be filed only for injury or illness incurred in combat; the law requires only that a disease or disability was incurred or aggravated during military service. If you need any further assistance, you may contact a Veterans Benefits Counselor by calling the VA toll-free telephone number 1-800-827-1000.

If a non-VA physician subsequently evaluates you and finds an new diagnosis, you are encouraged to provide the VA with all additional diagnoses, which will be included in your medical record as well as the IRR.

We trust this information is helpful to you.

Sincerely,
_____ (Name) _____

_____ (Registry Physician) _____

SAMPLE IONIZING RADIATION REGISTRY FOLLOW-UP LETTER (NO MEDICAL PROBLEMS)

(Date)
(Name/Address)

Dear_____:

We wish to acknowledge your recent participation in the Department of Veterans Affairs (VA) Ionizing Radiation Registry (IRR) Program. This effort should prove to be helpful in assisting us to serve you with the possible health problems that may have resulted from a radiation-risk activity during:

a. active military service; OR
b. as a member of a reserve component of the Armed Forces during a period of active duty for training or inactive duty training; OR
c. active military service for those persons who received nasopharyngeal irradium treatments).

As discussed at the conclusion of your visit, results of your examination and laboratory tests indicate that there are no detectable medical problems. At this time you have no reason to be concerned about any adverse health effects resulting from your active military service (either during the American occupation of Hiroshima and/or Nagasaki, Japan, and/or at the testing of a nuclear device, and/or as Prisoner of War during World War II with possible exposure to ionizing radiation, and/or treatment with Nasopharyngeal Radiation).

If a non-VA physician subsequently evaluates you and finds a new diagnosis, you are encouraged to provide the VA with all additional diagnoses, which will be included in your medical record as well as the IRR.

We trust this information is helpful to you.

Sincerely,

_____ (Name) _____

_____ (Registry Physician) _____

DEFINITIONS AND ACRONYMS

1. **Austin Automation Center (AAC).** The AAC, Austin, TX, is the location where code sheets are collected and data entered into the computerized registry.

2. **Automated Management Information System (AMIS).**

3. **Certified Nurse Practitioner (CNP).**

4. **Chief of Staff (COS).**

5. **Consolidated Health Record (CHR).** The CHR is a file containing medical records relating to patient identity, diagnosis, prognosis, or treatment at VA health care facility.

6. **Defense Special Weapons Agency (DSWA).** The DSWA was formerly the Defense Nuclear Agency (DNA) and is now identified at the Defense Threat Reduction Agency (DTRA)

7. **Defense Threat Reduction Agency (DTRA).** The DTRA was formerly the DSWA and DNA.

8. **Department of Defense (DOD).**

9. **Department of Veterans Affairs (VA).**

10. **Doctor of Osteopathy (D.O.).**

11. **Doctor of Medicine (M.D.).**

12. **Environmental Agents Service (EAS).** The EAS, VHA Headquarters, has the responsibility to coordinate and monitor all VHA activities, research and otherwise, relating to the ionizing radiation issue.

13. **Environmental Epidemiology Service (EES).** The EES, VA, is the Service responsible for providing epidemiological expertise to support clinical care as well as performing relevant research studies.

14. **Facility.** A facility is any VA entity which provides IRR examinations to veterans.

15. **Follow-up Examination.** A follow-up examination is an examination which is performed subsequent to the completed initial (first) examination. ***NOTE:*** *This is not a consultation associated with the initial examination.* Code sheets for the first follow-up examination are to be submitted to AAC. Code sheets for subsequent follow-up examinations, if performed, do not have to be submitted to the AAC unless there is a change in diagnosis.

16. **Initial Examination.** An initial examination is the first physical examination which is completed and sent to the AAC for the purpose of entering a veteran into the IRR system.

17. **Ionizing Radiation (IRAD).** Ionizing Radiation is any of the various forms of radiant energy that causes ionization when it interacts with matter. The most common types are alpha radiation, made up of helium nuclei; beta radiation, made up of electrons; and gamma and x rays, consisting of high-energy electromagnetic radiation.

18. **International Classification of Diseases – Clinical Modification (Ninth Edition) (ICD-9-CM).** The ICD-9-CM provides standardized classification of diseases.

19. **Ionizing Radiation Registry (IRR).** The IRR, managed centrally by the EAS in VA Headquarters, is a computerized index of veteran participants, and the coded findings of radiation physical examinations including related diagnostic data.

20. **Patient Treatment File (PTF).**

21. **Physician's Assistant (P.A.).**

22. **Prisoner of War (POW).**

23. **Records Control Schedule (RCS) 10-1.** The RCS-10-1 is a document providing instructions for record retention and disposition.

24. **Registry Coordinator (RC).** The RC is a non-physician responsible for administrative management of the Ionizing Radiation program at each VA medical facility.

25. **Registry Physician (RP).** The RP is responsible for clinical management of the Ionizing Radiation Program at each VA medical facility.

26. **SMA (6/12).** The SMA (6/12) is the Manufacturer's Trademark for a Chemistry Analyzer.

27. **Social Security Number (SSN).**

28. **Veterans Benefits Administration (VBA).**

29. **Veterans Benefits Counselor (VBC).**

30. **VA Form 10-0020A.** VA Form 10-0020A, the July 1999 edition, is the updated Ionizing Radiation Registry code sheet replacing the May 1987 edition of VA Form 10-0020A.

31. **VA Form 10-1079.** VA Form 10-1079 is the Emergency Medical Identification sticker which is to be affixed to front of CHR.

32. **VA Form 7252.** The VA Form 7252, May 1989, is the transmittal form for use in shipment of tabulating data. ***NOTE:*** *This form was previously numbered VA Form 30-7275.*

33. **Veterans Health Administration (VHA).**

34. **Veterans Health Information Systems and Technology Architecture (VISTA).** VA computer system (formerly called Decentralized Hospital Computer Program [DHCP]) that supports day-to-day operations at local VA health care facilities.

35. **Veterans Integrated Service Network (VISN).**

INSTRUCTIONS FOR COMPLETING VA FORM 10-0020A, IONIZING REGISTRY CODE SHEET

1. General Instructions for Completing VA Form 10-0020A

a. A legible copy of the original code sheet will be prepared and submitted to the Austin Automation Center (AAC), Austin, TX, in the initial and the first follow-up examinations (if required). The original code sheet will be filed in the medical record after verification for correctness by AAC. Additional follow-up examinations, as required, will continue to be documented in the Consolidated Health Record (CHR) and a code sheet will be prepared for the first follow-up examination and submitted to AAC. All subsequent code sheets for follow-up examinations will not be submitted to AAC, with the exception that if there is a change in diagnosis, then a code sheet will be prepared and submitted for entry into the Ionizing Radiation Registry (IRR).

b. Print clearly using a BLACK ball-point pen or a BLACK felt-tipped pen. Follow instructions carefully to ensure that ALL data fields are accurately completed. Enter one letter or number per block. The numeric zero must be slashed "0" to distinguish it from the alpha character, as Ø.

(1) Part I of the code sheet should be completed in the presence of the veteran.

(2) Part II of the code sheet should be completed at the time of the examination by the Registry Physician (RP) or alternate. Once completed, this code sheet should be returned to the Registry Coordinator (RC) for review and mailing to AAC.

2. Instructions for Completing Part I

Item 1. Facility Number and Suffix – Blocks 2-7.

Enter facility code as listed in the Department of Veterans Affairs (VA) Manual MP-6, Part XVI, Supplement Number 4.1, Appendix A. Use the Automated Management Information Systems (AMIS) suffix (BY, BZ, etc.) to indicate your satellite facility. DO NOT USE Q, R, or S.

Item 2. Last Name of Veteran – Blocks 8-33.

Beginning in Block 8, enter veteran's last name. Do not use accent marks in the name or skip blocks between the letters of the last name. Skip a block if the last name is followed with JR, SR, I, II, III, etc.

Item 3. First Name of Veteran – Blocks 34-48.

Beginning in Block 34, print the veteran's first name.

Item 4. Middle Name of Veteran – Blocks 49-58.

Beginning in Block 49, enter veteran's middle name or initial.

Item 5. Type of Examination – Block 59

The following transaction type should be entered in Block 59 as appropriate.

A – Initial examination. Veteran's first IRR examination.

B – To delete an entire initial examination with a noted error, after it has been accepted into the registry, resubmit the original code sheet, white out the "A" and enter a "B", using a RED pen or pencil. After the AAC has deleted this examination record from the registry dataset, submit another code sheet with the correct information with an "A." All fields must be completed on a resubmission.

C – Follow-up examination(s). Veteran's second and subsequent IRR examinations. Additional follow-up examinations (these are not consultations relating to the initial examination) required, will continue to be documented in the CHR, and a code sheet will not be prepared or submitted to AAC with the following exception: if a diagnoses differs from previously submitted code sheets, then a code sheet should be prepared and submitted for entry into the IRR.

D – to delete an entire follow-up examination with a noted error, after it has been accepted into the registry, resubmit the original code sheet with a "D" and after the AAC has deleted this record from the registry dataset, submit another code sheet with the correct information with a "C."

E – To submit a change in demographics (i.e., name, address or date of birth), enter "E." Complete items with name, Social Security Number (SSN), date of birth, and address. No other items need to be completed.

X – When a registry participant has been identified and verified as being deceased, enter "X." Complete items with name, SSN, and date of birth. No other items need to be completed. (AAC will retain these records in data set noting that veteran is deceased.)

Item 6. SSN – Blocks 60-69.

Block 60 is to be used ONLY if a pseudo SSN is being submitted. In this event, the letter "P" will be entered in Block 60. Leave Block 60 blank when the actual SSN is used as the AAC will enter the pseudo number in these blocks.

***NOTE**: See MP-6, Part XVI, Supplement Number 41, Chapter 2, for instruction on pseudo SSN assignment.*

Item 7. Service Serial Number – Blocks 70-79.

Beginning in Block 70, enter the Service Serial Number. Unused blocks remain blank. If the serial number begins with "US" Blocks 72-79 must be completed. Fill unused block(s) with "0" for this instance only. If the serial number is unknown, enter a "U" in Block 70. Unused blocks remain blank. However, every effort must be made to obtain the Service Serial Number as it will allow research staff to link this questionnaire to exposure data at the Defense Threat Reduction Agency.

Item 8. Date of Birth – Blocks 80-87.

Beginning in Block 80, enter numerical equivalent for the month, day and four digit year (e.g., 01/19/1950). All blocks must be completed.

Item 9. Claim Number – Blocks 88-95.

Beginning in Block 88, enter the VA claim number. If unknown, enter "U" in Block 88.

Item 10. Claimant's Telephone Number (include Area Code) – Blocks 96-105.

Beginning in Block 96, enter the veteran's current telephone number, including area code (if available).

Item 11. Address (Street Name and Apartment Number (if applicable) – Blocks 106-131

Beginning in Block 106, enter veteran's current street address, Post Office Box, etc. Leave one blank block between street number and name.

Item 12. City or Town, County, State, Zip Codes – Blocks 132-171

a. Block 132. Beginning in Block 132, enter veteran's city or town.

b. County and State. Enter name of county and state in fields without Block numbers.

c. Blocks 158-162. Enter the five-digit Zip Code.

d. Blocks 163-166. Optional – enter the extended four digit Zip Code.

e. Blocks 167-169. Enter County Code.

f. Blocks 170-171. Enter State Code.

Item 13. Sex. Block 172 – Enter either "M" for Male or "F" for Female.

Instructions for Completing Part II

Items 14 through 21 will be completed as indicated:

Item 14 . Did veteran receive nasopharyngeal radium treatments while in active military, naval or air service? Block 173

Enter in Block 173 one of the following codes: Y(es); N(o); or U(nknown)

Item 15. Is there Evidence of Birth Defects Among Veteran's Children or Grandchildren? Block 174

Enter in Block 174 one of the following codes: Y(es); N(o); or U(nknown). If "Yes, please describe birth defects in Item 18 – "Remarks."

Item 16. Date of Examination – Blocks 175-182

Enter in Blocks 175-182 the numerical equivalent for the month, day, and year (e.g., 11/17/1988). If the veteran did not want an examination, note this in Item 18 "Remarks" section, and do not send the code sheet to the AAC- file this code sheet in veteran's chart. All eligible veterans claiming exposure to ionizing radiation should be offered the IRR examination.

Item 17. Possible Radiogenic Related Disease(s) – Blocks 183-218

Enter one of the following codes in Blocks 183-218 listing possible radiogenic-related diseases: **Y(es); N(o); or U(nknown).**

All Blocks must be completed, as indicated on code sheet. ***NOTE:*** *Refer to paragraph 11, for ICD-9 codes identifying the following radiogenic related diseases.*

(1) Block 183 – None (If there were no radiogenic related diseases, enter a Y(es) in Block 183 and go to Item 18 "Remarks.)" No entries are required in Blocks 184-218.

(2) Block 184 – Leukemia, Lymphoid (except chronic lymphatic leukemia)

(3) Block 185 – Leukemia, Myeloid

(4) Block 186 – Leukemia, Monocytic

(5) Block 187 – Leukemia, Hairy Cell

(6) Block 188 – Leukemia, other

(7) Block 189 – Leukemia, unspecified cell type

(8) Block 190 – Thyroid Cancer

(9) Block 191 – Breast Cancer

(10) Block 192 – Lung Cancer (malignant neoplasm of trachea, bronchus and lung)

(11) Block 193 – Bone Cancer

(12) Block 194 – Primary Liver Cancer

(13) Block 195 – Skin Cancer

(14) Block 196 – Esophageal Cancer

(15) Block 197 – Stomach Cancer

(16) Block 198 – Colon Cancer

(17) Block 199 – Pancreatic Cancer

(18) Block 200 – Kidney Cancer

(19) Block 201 – Urinary Bladder Cancer

(20) Block 202 – Salivary Gland Cancer (malignant neoplasm of major salivary gland)

(21) Block 203 – Multiple Myeloma

(22) Block 204 – Posterior Subcapsular Cataracts

(23) Block 205 – Non-malignant Thyroid Nodular Disease

(24) Block 206 – Ovarian Cancer

(25) Block 207 – Parathyroid Adenoma

(26) Block 208 – Tumors of the brain and central nervous system

(27) Block 209 – Lymphomas other than Hodgkin's Disease

(28) Block 210 – Cancer of the Rectum

(29) Block 211 – Cancer of the Small Intestine

(30) Block 212 – Cancer of the Pharynx

(31) Block 213 – Cancer of the Bile Duct

(32) Block 214 – Cancer of the Gall Bladder

(33) Block 215 – Cancer of the Renal Pelves, Ureters, and Urethra

(34) Block 216 – Cancer of the Prostate

(35) Block 217 – Any other malignancies not previously listed; if Y(es), list on code sheet.

(36) Block 218 – Other possible radiogenic diseases; if Y(es) list on code sheet.
NOTE: *Other conditions may be recognized in the future.*

d. **Item 18. Remarks – Block 219 –** This section should be used for noting informational comments, if applicable, such as elaborating on birth defects, noting if the examination was not performed, identifying the veteran's military unit assignment, etc. Also, if veteran is deceased, indicate so, and give the date of death, if available. ***NOTE:*** *Enter one of the following codes in* ***Block 219*** *indicating that you have or have not made any remarks in Item 18: Y=Y(es) or N=N(o)*

Item 19. Name of Examiner or RP (Print in Full).

Item 20 . Title of Examiner (Full Title).

Item 21. Signature of Examiner.

Item 22. Signature of RP (if other than examiner). The name and title of the examiner should be printed in the spaces provided and accompanied by the signature.

Department of Veterans Affairs	IONIZING RADIATION REGISTRY CODE SHEET

TT	#2	Facility Number (Use PTF No. only) (2 - 4)				Suffix (5 — 7)			

The information the veteran supplies may be disclosed outside the VA to Federal, State and local government agencies and National Health Organizations to assist in the development of programs for research purposes and other uses as stated in the "Notice of Systems of VA Records" published in the Federal Register in accordance with the Privacy Act of 1974.

INSTRUCTIONS: Please print. Use only one letter or number per block, with left justification. If possible use black ballpoint or felt-tip pen. Shaded areas are for VA use only.

PART I - OBTAIN THIS INFORMATION FROM PATIENT'S CHART ONLY.

2. LAST NAME (8-33)			5.Type (59)
3. FIRST NAME (34-48)	4. MIDDLE NAME (49-58)		

6. SOCIAL SECURITY NUMBER (60 - 69) Begin entering Social Security No. in Block 61. If psuedo-number, enter P in Block 60. (60) (61) (62) (63) (64) (65) (66) (67) (68)	7. SERVICE SERIAL NO. (Begin at left, leave unused blocks blank.) Enter "U" if service number is unknown (70 - 79)	8. DATE OF BIRTH (80-87) Month	Day	Year

9. CLAIM NUMBER. Enter "U" if claim number is unknown. (88-95)	10. CLAIMANT'S TELEPHONE NUMBER (Include Area Code, If available) (96-105)

11. ADDRESS (Street Name and Apartment Number (If applicable)					
12. CITY OR TOWN (132-157)					
COUNTY	STATE	ZIP CODE (158-162)	PLUS 4 -OPTIONAL (163-166)	COUNTY (167-169)	STATE (170-171)

13. SEX (Enter one code at right) M = Male F = Female	172	14. Did veteran receive nasopharyngeal radium treatments while in active military, naval or air service? (Enter one of the following codes at right in Block 173.) Y=Yes N=No U=Unknown	173

PART II. TO BE COMPLETED BY EXAMINING PHYSICIAN OR PROGRAM COORDINATOR

15. IS THERE EVIDENCE OF BIRTH DEFECTS AMONG VETERAN'S CHILDREN OR GRANDCHILDREN *Choose one of the following codes: Y=Yes N=No U=Unknown. Enter code in Block 174.*	174	16. DATE OF EXAM (175-182) Month	Day	Year

17. POSSIBLE RADIOGENIC-RELATED DISEASE(S) *Choose one of the following codes: Y=Yes N=No U=Unknown. (Enter code in blocks 183-191)*	BLOCK	CODE
(1) NONE, (If yes, go to Item 18, "REMARKS")	183	
(2) LEUKEMIA, LYMPHOID (except chronic lymphatic leukemia, to be included in Item 35 below)	184	
(3) LEUKEMIA, MYELOID	185	
(4) LEUKEMIA, MONOCYTIC	186	
(5) LEUKEMIA, HAIRY CELL	187	
(6) LEUKEMIA, OTHER	188	
(7) LEUKEMIA, UNSPECIFIED CELL TYPE	189	
(8) THYROID CANCER	190	
(9) BREAST CANCER	191	

IONIZING RADIATION REGISTRY CODE SHEET, Continued	NAME	SSN	
17. POSSIBLE RADIOGENIC-RELATED DISEASE(S), CONTINUED FROM PAGE 1		BLOCK	CODE
Choose one of the following codes: Y=Yes N=No U=Unknown. (Enter code in blocks 192-217)			
(10) LUNG CANCER, (malignant neoplasm of trachea, bronchus, &		192	
(11) BONE CANCER		193	
(12) PRIMARY LIVER CANCER		194	
(13) SKIN CANCER		195	
(14) ESOPHAGEAL CANCER		196	
(15) STOMACH CANCER		197	
(16) COLON CANCER		198	
(17) PANCREATIC CANCER		199	
(18) KIDNEY CANCER		200	
(19) URINARY BLADDER CANCER		201	
(20) SALIVARY GLAND CANCER (malignant neoplasm of major salivary gland)		202	
(21) MULTIPLE MYELOMA		203	
(22) POSTERIOR SUBCAPSULAR CATARACTS		204	
(23) NONMALIGNANT THYROID NODULAR DISEASE		205	
(24) OVARIAN CANCER		206	
(25) PARATHYROID ADENOMA		207	
(26) TUMORS OF THE BRAIN & CENTRAL NERVOUS SYSTEM		208	
(27) LYMPHOMAS OTHER THAN HODGKINS DISEASE		209	
(28) CANCER OF THE RECTUM.		210	
(29) CANCER OF THE SMALL INTESTINE		211	
(30) CANCER OF THE PHARYNX		212	
(31) CANCER OF THE BILE DUCT		213	
(32) CANCER OF THE GALL BLADDER		214	
(33) CANCER OF THE RENAL PELVES, URETERS & URETHRA		215	
(34) CANCER OF THE PROSTATE		216	
(35) ANY OTHER MALIGNANCIES NOT PREVIOUSLY LISTED *(Enter one code at right Y = Yes N=No)* If Yes, list below:		217	
(36) OTHER POSSIBLE RADIOGENIC DISEASES (Other conditions may be recognized in the future.) (Enter one code at right Y = Yes N=No) If Yes, list below:		218	
18. REMARKS (Please indicate whether you have made any remarks by entering one code at right.		219	
19. NAME OF EXAMINER/REGISTRY PHYSICIAN (PRINT FULL NAME)			
20. TITLE OF EXAMINER (FULL TITLE)			
21. SIGNATURE OF EXAMINER			
22. SIGNATURE OF REGISTRY PHYSICIAN			

INSTRUCTIONS FOR PROCESSING CODE SHEETS

1. Submission of VA Form 10-0020A, Ionizing Radiation Registry Code Sheet to the Austin Automation Center (AAC) (formerly the Data Processing Center, Austin, TX).

Completed, legible copies of code sheets are submitted to the AAC to be entered into the Ionizing Radiation Registry (IRR). Code sheets should be scanned to ensure all required fields are completed. ***NOTE:*** *No medical record documentation should be attached to these code sheets.*

2. Batching of Code Sheets

a. Code sheets should be stapled in the upper-left hand corner. Completed code sheets will be batched in groups of no more than 25. Divisions of a consolidated facility must keep submissions separate, i.e., each batch will include code sheets from one facility.

b. Corrected code sheets do not have to be batched separately. They can be mailed with the regular code sheets as long as they are from the same facility.

c. If a veteran has had two examinations within the same mailing period, that is, an initial and follow-up examination, only the initial examination code sheet should be submitted in the batch. Hold the follow-up examination code sheet until it is certain the AAC has processed and accepted the initial examination code sheet. If submitted simultaneously, an error message may occur (see par. 6).

3. Transmittal Form

a. Two copies of the VA Form 7252, Transmittal Form for the Use in Shipment of Tabulating Data, will accompany each batch of code sheets. One copy will be retained at the AAC and the other copy will be returned by the AAC to the transmitting facility with the code sheets and the edit analysis printout, entitled "Transaction Report – Part II – Invalid Transactions." "Transaction Report – Part II, Valid Transactions," (code sheets that were accepted and data entered into the AAC dataset) will also be sent to the facility of origin, but will not include copies of code sheets.

b. If there were no examinations and/or code sheets processed for the month, no transmittal form is required.

c. Completion of VA Form 7252 is as follows (see sample):

Item 1 – Addressee – Department of Veterans Affairs, Austin Automation Center (200/397A), 1615 Woodward Street, Austin, TX 78772-0001, ATTN: Input/Data Entry Contract Control/VADS Function.

Item 2 – Facility name and address – Enter facility name and address.

Item 3 – Reply reference – Enter facility number and routing symbol.

Item 4 – Leave blank.

Item 5 – Number of packages – Enter number of batches.

Item 6 – Dispatch date – Enter date submitting to AAC.

Item 6a – Final batch – Leave blank.

Item 7 – Official responsible for shipment – Enter name, title, and telephone number of individual responsible for transmitting code sheets to the AAC.

Item 8 – Tabulating data.

Column A – Leave blank.

Column B – Job Number – Enter "10" in first segment and "20A1" in second segment.

Column C – Description – First line enter "IONIZING RADIATION", second line enter "Facility Number," third line enter "Month Ending," fourth line enter "Batch Number," fifth line enter "Code Sheet Count," and sixth line enter "Cumulative Count (for calendar year)."

Columns D and E – Leave blank.

Item 9 – Remarks – Enter "VA Form 10-0020A's," and provide breakdown of "code sheet count" (Line 5) i.e. (5) initial (Type A), (2) follow-up (Type C), (1) deceased (Type X), etc.

4. Control Log

a. An Ionizing Radiation (IRAD) control log will be established and maintained at each facility. As batches are prepared for submission to the AAC an entry should be made on the batch control log. Using the control log, assign the appropriate number and record it on the transmittal form. Begin with batch number ~~00~~1 for January of each year and continue with sequential numbers throughout the year, i.e., if there are 50 code sheets to be submitted to the AAC during the month of January, two batches will be prepared with the control log numbers ~~00~~1 and ~~00~~2.

b. The Control Log should consist of the following:

(1) Facility code number;

(2) Batch number assigned sequentially by facility beginning with ~~00~~1 in January of each year (also, to be recorded on transmittal sheet);

(3) Number of code sheets in the batch (also, to be recorded on transmittal sheet);

(4) Date the batch(es) was (were) mailed to the AAC; and

(5) Date the batch(es) and associated edit output was (were) returned from the AAC.

5. Mailing

a. Code sheets will be submitted to the AAC monthly.

b. The mailing address for the AAC is:

Department of Veterans Affairs
Austin Automation Center (200/397A)
1615 Woodward Street
Austin, TX 78772
ATTN: Input/Data Entry Contract Control/VADS Function

c. The AAC will process the data from the code sheets once each month (25th). The AAC will return all rejected code sheets with the printout "Transaction Change and Error (Reject) Listing" to the transmitting facility. Code sheets that are correct and entered into the IRR dataset will not be returned to VA facilities. ***NOTE:*** *Rejected Code sheets should be corrected and returned to the AAC within 10 working days following receipt from the AAC.*

d. It is not appropriate to call the AAC in regard to questions on code sheet completion or correction. These questions should be referred to the Registry Coordinator (131), VHA Headquarters.

6. Transaction Reports

a. A computerized printout "Transaction Report – Part I – Valid Transactions" will be returned by the AAC to the transmitting facility listing the veteran's last name, middle initial, Social Security Number, type and date of examination. Since these code sheets were valid and data entered into the AAC registry, code sheets will not be returned to the facility of origin. They will be forwarded to Veterans Health Administration (VHA) Headquarters for archiving. This report may include the following information:

"Message – Transaction accepted, initial examination already established at (facility number); transaction will be processed as a follow-up examination for your facility."

Action – This code sheet does not have to be resubmitted to the AAC. It has been accepted as a follow-up examination. Indicate facility number where initial examination was obtained on computerized or card file. Also, the cumulative number of examinations in the monthly statistical report must be adjusted accordingly.

b. A computerized printout entitled "Transaction Report – Part II – Invalid Transactions" will be returned to the transmitting facility with the rejected code sheets. These printouts will list the veteran's last name, first name, middle initial, Social Security Number, type and date of examination and describe the rejected or invalid field name, code sheet location, data, reason for rejection and fields to verify with any additional explanatory information.

NOTE: *Facilities should verify the number of code sheets sent to the AAC against the Transaction Reports.*

c. Invalid or rejected code sheets where data has not been entered into the dataset are to be corrected as follows:

(1) White-out the incorrect entries and enter the correct data with RED pen or RED felt-tipped pen; OR

(2) Prepare a new code sheet with the corrections in the appropriate field(s). If a new code sheet is prepared for the return of a correction, do not complete just the corrected field(s) – ALL of the fields must be completed as if it were an initial input.

d. Examples of the messages on the "Transaction Report – Part II – Invalid Transaction:"

(1) "Rescinded VA Form 10-0020A, TT no longer valid. Use revised VA Form 10-0020A, TT.

(2) "Required entry not made."

(3) "Response must be either a "Y,," "N," or "U."

(4) "Response must be either a "M" or "F."

(5) "Zip Code is invalid for State."

(6) "Duplicate Follow-up Segment."

Action – This message will appear if the examination date on the code sheet submitted on the veteran is identical to an examination date already existing in the registry. There is the possibility of a coding or entry error. Examination date should be verified using the computerized log, veteran's medical record, or AAC printouts. If there is a duplicate record, it should be deleted by submitting a code sheet in accordance with instructions for deleting a record (see App. D, Item 5.)

(7) "Message – No matching initial exam"

Action – When deletion of an initial record in the registry is attempted, the code sheet submitted with a type "B" must have the identical information as on the original record previously accepted into the registry, otherwise the deletion process cannot be carried out. Correct code sheet and resubmit to AAC within 10 working days.

7. Master File List

Twice annually (February and August) AAC will provide all facilities with a computerized printout entitled, "Ionizing Radiation Registry Master File List." This is a listing of all veterans who have been examined and accepted into the automated registry system. This AAC-generated master listing will assist in the verification of veterans who have been accepted into the system nationwide. This list will contain the following information:

a. Veteran's full name,

b. Social Security Number,

c. Date of examination,

d. Type of examination (initial and/or follow-up), and

e. Facility where examination was performed.

8. Master Record Type (MRT)

The MRT or record type, associated with each transaction (i.e., each veteran's examination) is listed on the computerized printout. The MRT is generated by the automated IRR system after processing of the code sheets (transactions) submitted by facilities to the AAC. ***NOTE:*** *These printouts records will be replaced by Facility access to AAC IRAD dataset in the near future.*

NOTE: *The MRT should not be confused with the transaction "Type" (Item 5) which is indicated on VA Form 10-0020A.*

SAMPLE OF VA FORM 7252, TRANSMITTAL FORM FOR USE IN SHIPMENT OF TABULATING DATA

Department of Veterans Affairs

TRANSMITTAL FORM FOR USE IN SHIPMENT OF TABULATING DATA

1. ADDRESSEE	2. STATION NAME AND ADDRESS	
	3. REPLY REFERENCE *(Sta. no./symbol)*	4. EFFECTIVE DATE OF DATA

5. NO. OF PACKAGES	6. DISPATCH DATE	6A. FINAL BATCH *(Check)* ☐	7. OFFICIAL RESPONSIBLE FOR SHIPMENT *(Name, title and signature)*

8. TABULATING DATA

REPORTS CONTROL SYMBOL (A)	JOB NUMBER (B)	DESCRIPTION (C)	NO. OF COPIES OF REPORTS (D)	CARD COUNT (E)

9. REMARKS

VA FORM SEP 1992(R) **7252**

APPENDIX 3

Department of Veterans Affairs
Veterans Health Administration
Washington, DC 20420

DIRECTIVE 98-032

July 9, 1998

EVALUATION PROTOCOL FOR GULF WAR VETERANS WITH POTENTIAL EXPOSURE TO DEPLETED URANIUM (DU)

1. PURPOSE

This Veterans Health Administration (VHA) Directive outlines the policy and procedures for evaluating Gulf War veterans with possible exposure to depleted uranium (DU).

2. BACKGROUND

a. DU is natural uranium left over after most of the U-235 isotope has been removed; such as that used as fuel in nuclear power plants. It is about half as radioactive as natural uranium and is a radiation hazard primarily if internalized, such as in shrapnel, contaminated wounds, and inhalation. In addition to its radioactivity, DU has some chemical toxicity related to being a heavy metal (similar to lead).

b. During the Gulf War, DU was used by the United States military in projectiles and armor for tanks. Service personnel who may have had potential inhalation exposures to DU include those on, in, or near vehicles hit with "friendly fire," rescuers entering burning vehicles, individuals near fires involving DU munitions, individuals salvaging damaged vehicles, and those near burning vehicles.

c. The medical effects of DU exposure are continuing to be evaluated. A group of Gulf War veterans with retained DU fragments or DU-contaminated wounds is being followed at a special DU Program at the Department of Veterans Affairs (VA) Medical Center, Baltimore, MD. While no clinically significant adverse effects of DU have been evident to date in this group, some abnormalities have been detected on specialized testing.

d. The Baltimore DU Follow-up Program has determined that for Gulf War friendly fire victims, a 24-hour urine determination for uranium is a more sensitive screening test for DU than whole-body counting.

e. For additional background information on DU see the references in paragraph 6.

f. The Austin Automation Center (AAC) functions as the "contractor" to VHA in providing national level computer support for this DU program.

3. POLICY

Each VHA facility will use the DU protocol examination to evaluate Gulf War veterans identified and referred by the Department of Defense (DOD) or those veterans who self-refer because they are concerned about potential inhalation exposure to DU according to the protocol outlined in paragraph 4.

4. ACTIONS

a. VA Gulf War Registry programs will provide DU protocol examinations to Gulf War veterans identified by DOD. VA medical centers will be notified by Gulf War program staff that a veteran has been referred by DOD to their medical facility for the DU protocol examination.

b. The DU protocol consists of a Gulf War Registry examination, DU exposure questionnaire and a 24-hour urine collection for creatinine and uranium.

c. The exposure history contained on VA Form 10-9009D, Depleted Uranium (DU) Questionnaire, (see Att. A) will be administered to each veteran who is concerned about possible DU exposure. Any positive responses to the DU questionnaire are to be followed up with more detailed history-taking by the examining healthcare provider. The full exposure history will be recorded in the veteran's consolidated health record (CHR). All free text on the DU questionnaires will be included in the CHR, but not in the Registry dataset at AAC. Veterans should be asked if they are willing to have their data shared with DOD, and their response entered on the DU code sheet supplement, question 43. If yes, VA Form 70-3288, Request for and Consent to Release of Information From Claimant's Records, (see Att. C) should be completed and filed in the veteran's Consolidated Health Record. Completed DU questionnaires will be submitted to AAC on completion of protocol examination.

d. If the veteran was not identified by DOD as possibly DU exposed, but information provided during the examination of the veteran suggests that the veteran may have had a significant exposure to DU or if the veteran has a high level of concern that such an exposure occurred despite counseling by the healthcare provider, a DU protocol examination should be completed. The health care provider will contact the DU Follow-up Program at the Baltimore VA Medical Center (1-800-815-7533) to discuss obtaining a 24-hour urine collection for uranium.

e. The 24-hour urine collection for uranium will be performed in accordance with instructions in Attachment B.

f. Upon completion of the protocol examination, the Gulf War Registry code sheet and the DU exposure questionnaire will be forwarded by the Registry Coordinator to AAC for entry of the examination results into the Gulf War Registry database. ***NOTE: If the veteran has already had a Gulf War Registry exam, only the DU code sheet will be sent to AAC.***

g. Results of the 24-hour urine for uranium will be communicated directly to the veteran by letter from the Baltimore DU Follow-up Program with a copy to the VA referring physician for the veteran's CHR. The Baltimore DU program staff will also forward the urine uranium results to AAC for entry into the Registry database.

h. Follow-up actions for any veteran with an elevated 24-hour urine uranium determination will be individualized based on discussion between the veteran's primary VA physician and the staff at the Baltimore DU Follow-up Program.

i. Additional diagnostic evaluation of signs or symptoms identified during the examination should be completed as clinically indicated. Eligible veterans who wish to have VA follow-up care should be assigned to a primary care team.

5. REFERENCES

a. Voelz, George L., Chapter 13 – "Uranium," in Hazardous Material Toxicology, Eds. Sullivan, John B. and Krieger, Gary R.Williams and Wilkins, Baltimore, MD, 1992.

b. Health Effects of Depleted Uranium – Fact Sheet, Department of Defense, June 11, 1993. ***NOTE****: Copies can be obtained by calling (703) 697-3189.*

c. "Agency for Toxic Substances and Disease Registry," U.S. Public Health Service. 1990.

d. Toxicologic Profile for Uranium. PB91-180 471, US. Department of Commerce, National Technical Information Service. ***NOTE:*** *Customer Service is (703) 487-4660.*

e. "Depleted Uranium," A Guide to Gulf War Veterans' Health, Department of Veterans Affairs, Employee Education System, St Louis Center (14B/JB), St. Louis, MO 63125

6. FOLLOW-UP RESPONSIBILITY

The Chief Public Health and Environmental Hazards Officer (13) is responsible for the contents of this directive. Questions about DU should be addressed to the Baltimore DU Follow-up Program at 1-800-815-7533; General questions about the protocol should be addressed to the Environmental Agents Service at (202) 273-8580.

7. RESCISSION

This VHA Directive will expire July 9, 2003.

S/ by Thomas Garthwaite, M.D. for
Kenneth W. Kizer, M.D., M.P.H.
Under Secretary for Health

Attachments

DISTRIBUTION:

CO:	E-mailed 7/14/98
FLD:	VISN, MA, DO, OC, OCRO and 200 – FAX 7/14/98
EX:	Boxes 104, 88, 63, 60, 54, 52, 47 and 44 – FAX 7/14/98

THIS DIRECTIVE EXPIRES JULY 9, 2003

ATTACHMENT A

Department of Veterans Affairs

DEPLETED URANIUM (DU) QUESTIONNAIRE (SUPPLEMENT TO GULF WAR CODESHEET, VA FORM 10-9009D(RS)

TT	#1	Facility Number (Use PTF No. only) (2 - 4)				Suffix (5 – 7)			

The information the veteran supplies may be disclosed outside the VA to Federal, State and local government agencies and National Health Organizations to assist in the development of programs for research purposes and other uses as stated in the "Notice of Systems of VA Records" published in the Federal Register in accordance with the Privacy Act of 1974.

INSTRUCTIONS: Registry Physician or Coordinator: Please print. Use only one letter or number per block. If possible use black ballpoint or felt-tip pen. Shaded areas are for VA use only. All free text on this code sheet will be retained in medical health record but not included in the registry dataset at AAC.

PART IV (DEPLETED URANIUM [DU])

2. LAST NAME (8-33)

3. FIRST NAME (34-48)

4. SOCIAL SECURITY NUMBER (49-58)

P

5. PHONE NUMBERS WHERE YOU MAY BE CONTACTED:

5A. DAYTIME PHONE (59-68) ( ) -

5B. EVENING PHONE (69-78) ( ) -

7. *TODAY'S DATE (79-86)*
e.g. 05191998 (May 19, 1998)

6. *DATE OF ARRIVAL IN PERSIAN GULF WAR THEATRE OF OPERATION (87-94)*
e.g. 06191991 (June 19, 1991)

7. *DATE OF DEPARTURE FROM PERSIAN GULF WAR THEATRE OF OPERATION (95-102)*
e.g. 11121991 (November 12, 1991)

TO BE COMPLETED BY REGISTRY COORDINATOR OR PHYSICIAN

Instructions: Please respond to all questions entering one of the listed codes in Column (b).	(a) BLOCK	(b) CODE
9. WHO REFERRED YOU TO THE VA MEDICAL CENTER FOR EVALUATION? Code "a" = Office of the Special Assistant for Gulf War Illness (OSAGWI) of Department of Defense? Code "b" = Another Department of Defense Office Code "c" = Department of Veterans Affairs (VA) Code "d" = Self Referred Code "e" = Other sources (identify on following lines)_____ _____	103	
10. WHERE DID YOU SERVE? Enter Code "Y"= Yes or "N"= No in Blocks 104a through 104e.		
10a. Code "a" = Kuwait	104a	
10b. Code "b" = Saudi Arabia	104b	
10c. Code "c" = Iraq	104c	
10d. Code "d" = Only on a ship (not ashore)	104d	

DEPLETED URANIUM QUESTIONNAIRE, Continued	SSN									

	(a) BLOCK	(b) CODE
10e. Code "e" = Other (identify on following lines) _____	104e	
Instructions: Choose one of the following codes for Questions 11 through 39, unless other codes are listed or a narrative Response is required: Code "Y" = Yes Code "N" = No Code "D" = Don't Know		
11. WERE YOU A LOGISTICS ASSISTANCE REPRESENTATIVE (LAR) WHO INSPECTED DEPLETED URANIUM CONTAMINATED SYSTEMS TO DETERMINE REPAIRABILITY?	105	
12. WERE YOU A MEMBER OF A BATTLE DAMAGE ASSESSMENT TEAM (BDAT) WHO EXAMINED U.S. COMBAT VEHICLES KNOWN, OR SUSPECTED TO BE, DAMAGED OR DESTROYED BY DU?	106	
13. WERE YOU A MEMBER OF THE 144TH SERVICE AND SUPPLY COMPANY WHO PROCESSED DAMAGED EQUIPMENT, INCLUDING SOME WITH DU CONTAMINATION?	107	
14. WERE YOU A MEMBER OF A RADIATION CONTROL (RADCON) TEAM DEPLOYED IN THE PERSIAN GULF?	108	
15. WERE YOU INVOLVED IN THE EXAMINATION OR RECOVERY OF DAMAGED OR DESTROYED ENEMY VEHICLES?	109	
16. WERE YOU INVOLVED IN THE DOWNLOADING OF EQUIPMENT OR MUNITIONS FROM VEHICLES KNOWN OR SUSPECTED TO BE CONTAMINATED BY DU?	110	
17. WERE YOU A MEMBER OF A UNIT MAINTENANCE TEAM PERFORMING MAINTENANCE ON OR IN SYSTEMS KNOWN OR SUSPECTED TO BE CONTAMINATED BY DU?	111	
18. WERE YOU AT DOHA ON JULY 11, 1991, AT THE TIME OF THE FIRE?	112	
18a. WERE YOU DIRECTLY INVOLVED IN CLEAN-UP OPERATIONS FOLLOWING THE DOHA EXPLOSION AND FIRE?	112a	
18b. WERE YOU EXPOSED TO SMOKE FROM BURNING DOHA ROUNDS?	112b	
19. WERE YOU IN OR ON A VEHICLE HIT BY ENEMY FIRE AT THE TIME IT WAS HIT? IF "NO," SKIP TO QUESTION 20.	113a	
19a. IF "YES," WHAT TYPE OF A VEHICLE?		
19a(1). Code "a" = ABRAMS battle tank	113b	
19a(2) Code "b" = BRADLEY fighting vehicle	113c	
19a(3). Code "c" = Other (identify as follows) :	113d	
19a(4). Code "d" = Don't know	113e	
19b. IF "YES," WAS THE VEHICLE HIT BY DU MUNITIONS?	113f	
20. DID YOU ENTER AN ABRAMS BATTLE TANK TO PERFORM RESCUE OPERATIONS IMMEDIATELY AFTER IT WAS STRUCK BY ENEMY FIRE?	114	
21. DID YOU ENTER AN ABRAMS BATTLE TANK TO RETRIEVE SENSITIVE ITEMS IMMEDIATELY AFTER IT WAS STRUCK BY ENEMY FIRE?	115	
22. DID YOU ENTER A BRADLEY FIGHTING VEHICLE TO PERFORM RESCUE OPERATIONS IMMEDIATELY AFTER IT WAS STRUCK BY ENEMY FIRE?	116	
23. DID YOU ENTER A BRADLEY FIGHTING VEHICLE TO RETRIEVE SENSITIVE ITEMS IMMEDIATELY AFTER IT WAS STRUCK BY ENEMY FIRE?	117	

DEPLETED URANIUM QUESTIONNAIRE, Continued	SSN									

	(a) BLOCK	(b) CODE
24. WERE YOU IN OR ON ANY VEHICLE HIT BY FRIENDLY FIRE AT THE TIME IT WAS HIT? IF "NO," SKIP TO QUESTION 25.	118	
24a. IF "YES," WHAT TYPE OF VEHICLE?		
24a(1). Code" a" = ABRAMS battle tank	118a	
24a(2), Code "b" = BRADLEY fighting vehicle	118b	
24a(3). Code "c" = other (identify on following lines)	118c	
24a(4). Code "d" = Don't Know	118d	
24b. WAS THE VEHICLE HIT BY DU MUNITIONS?	118e	
25. DID YOU ENTER AN ABRAMS BATTLE TANK TO PERFORM RESCUE OPERATIONS IMMEDIATELY AFTER IT WAS STRUCK BY FRIENDLY FIRE?	119	
26. DID YOU ENTER AN ABRAMS BATTLE TANK TO RETRIEVE SENSITIVE ITEMS IMMEDIATELY AFTER IT WAS STRUCK BY FRIENDLY FIRE?	120	
27. DID YOU ENTER A BRADLEY FIGHTING VEHICLE TO PERFORM RESCUE OPERATIONS IMMEDIATELY AFTER IT WAS STRUCK BY FRIENDLY FIRE?	121	
28. DID YOU ENTER A BRADLEY FIGHTING VEHICLE TO RETRIEVE SENSITIVE ITEMS IMMEDIATELY AFTER IT WAS STRUCK BY FRIENDLY FIRE?	122	
29. DID YOU ENTER ANY ENEMY VEHICLE TO PERFORM RESCUE OPERATIONS IMMEDIATELY AFTER IT WAS STRUCK BY OUR FIRE? IF "NO," SKIP TO QUESTION 30.	123	
29a(1). Code "a" = Tank	123a	
29a(2) Code " b" = Other tracked vehicle (identify on following lines)	123b	
29a(3). Code "c" = Truck	123c	
29a(4). Code "d" = Other wheeled vehicle (identify on following lines)	123d	
29a(5). Code "e" = Other type vehicle (identify on following lines)	123e	
29a(6). Code "f" = Don't know	123f	
30. DID YOU ENTER ANY ENEMY VEHICLE TO RETRIEVE SENSITIVE ITEMS OR INTELLIGENCE MATERIAL IMMEDIATELY AFTER IT WAS STRUCK BY OUR FIRE? IF "NO," SKIP TO QUESTION 31.	124	
30a. IF "YES," WHAT TYPE OF VEHICLE?		
30a(1). Code "a" = Tank	124a	

DEPLETED URANIUM QUESTIONNAIRE, Continued	SSN:									

	(a) BLOCK	(b) CODE
30a(2) Code " b" = Other tracked vehicle (identify on following lines)	124b	
30a(3). Code "c" = Truck	124c	
30a(4). Code "d" = Other wheeled vehicle (identify on following lines)	124d	
30a(5). Code "e" = Other type vehicle (identify on following lines)	124e	
30a(6). Code "f" = Don't know	124f	
31. WERE YOU EXPOSED TO SMOKE FROM ANY ENEMY EQUIPMENT STRUCK BY DU ROUNDS?	125	
32. DID YOU REMOVE EQUIPMENT OR OTHER ITEMS FROM A DAMAGED OR DESTROYED U.S. OR ENEMY VEHICLE? IF "NO," SKIP TO QUESTION 33.	126	
32a. If you removed something from a vehicle, please describe it on the following lines:		
32b. Do you still have equipment or other items removed from a damaged or destroyed U.S. or enemy vehicle?	126a	
33. WERE YOU WITHIN 50 METERS OF A VEHICLE WHEN IT WAS HIT (NOT INCLUDING VEHICLES YOU WERE IN OR ON THAT WERE HIT)? IF "NO," SKIP TO QUESTION 34.	127	
33a. IF YES, WHAT TYPE OF VEHICLE?		
33a(1). Code a = ABRAMS battle tank	127a	
33a(2). Code b = BRADLEY fighting vehicle	127b	
33a(3). Code c = other (identify on following lines)	127c	
33a(4). Code d = Don't Know	127d	
33b. WAS THE VEHICLE HIT BY DU MUNITIONS?	127e	
34. DID YOU BREATH SMOKE OR DUST FROM VEHICLES HIT BY ENEMY OR FRIENDLY FIRE? IF "NO," SKIP TO QUESTION 35.	128	
34a. IF "YES," WHAT TYPE OF VEHICLE?		
34a(1). Code "a" = ABRAMS battle tank	128a	
34a(2), Code "b" = BRADLEY fighting vehicle	128b	
34a(3). Code "c" = other (identify on following lines)	128c	
34a(4). Code "d" = Don't Know	128d	
34b. WAS THE VEHICLE HIT BY DU MUNITIONS?	128e	

DEPLETED URANIUM QUESTIONNAIRE, Continued	SSN									

	(a) BLOCK	(b) CODE
35. DID YOU CLIMB ON OR ENTER VEHICLES HIT BY ENEMY OR FRIENDLY FIRE SOMETIME AFTER THE IMMEDIATE POST-IMPACT RESCUE PERIOD? IF "NO," SKIP TO QUESTION 36.	129	
35a. IF "YES," WHAT TYPE OF VEHICLE?		
35a(1). Code "a" = ABRAMS battle tank	129a	
35a(2), Code "b" = BRADLEY fighting vehicle	129b	
35a(3). Code "c" = Other (identify on following lines)	129c	
35a(4). Code "d" = Don't Know	129d	
35b. HOW MANY TIMES?		
35b(1). Code "a" = 1 Time	129e	
35b(2), Code "b" = 2 Times	129f	
35b(3). Code "c" = 3- 10 times	129g	
35b(4). Code "d" = More than 10 times	129h	
35b(5). Code "e" = Don't know	129I	
35c. HOW LONG (IN TOTAL) WERE YOU ON BOARD THE VEHICLE(S)?		
35c1). Code "a" = Less than 5 minutes	129j	
35c(2), Code "b" = 5-15 minutes	129k	
35c(3). Code "c" = 16-30 minutes	129l	
35c(4). Code "d" = More than 30 minutes	129m	
35c(5). Code "e" = Don't know	129n	
35d. WAS THE VEHICLE KNOWN TO BE CONTAMINATED WITH DU?	129o	
36. DID YOU PASS WITHIN 50 METERS (45.72 YARDS) OF A DAMAGED OR DESTROYED VEHICLE? IF "NO," SKIP TO QUESTION 37.	130	
36a. HOW LONG (IN TOTAL) AFTER THE DESTRUCTIVE EVENT?		
36a(1) Code "a" – Less than 12 hours	130a	

DEPLETED URANIUM QUESTIONNAIRE, Continued	SSN									

36a(2), Code "b" = 12 hours – 24 hours	130b	
36a(3). Code "c" = more than 24 hours	130c	
36a(4). Code "d" = Don't know	130d	
36b. IF "YES," WHAT TYPE OF VEHICLE?		
36b(1). Code "a" = ABRAMS battle tank	130e	
36b(2), Code "b" = BRADLEY fighting vehicle	130f	
36a(3). Code "c" = Other (identify on following lines)	130g	
36a(4). Code "d" = Don't Know	130h	
36c. WAS THE VEHICLE BURNING?	130I	
37. WERE YOU WOUNDED AS A RESULT OR BEING IN, ON, OR WITHIN 50 METERS (45.72 YARDS) OF THE DAMAGED VEHICLE AT THE TIME IT WAS HIT? IF "NO," SKIP TO QUESTION 38.	131	
37a. WHERE YOU WOUNDED?		
37a(1) Code "a" = leg/foot	131a	
37b(2). Code "b" = arm/hand	131b	
37c(3). Code "c" = face/head	131c	
37d(4). Code "d" = neck	131d	
37e(5). Code "e" = body	131e	
37b. DO YOU HAVE RETAINED FRAGMENTS OR SHRAPNEL IN YOUR BODY?	131f	
38. DID YOU FIRE DU ROUNDS?	132	
39. DID YOU HANDLE BARE OR DAMAGED DU PENETRATOR ROUNDS? IF "NO," SKIP TO QUESTION 40.	133	
39a. DID YOU HANDLE THE ROUNDS WITH GLOVES?	133a	
39b. DID YOU HANDLE THE ROUNDS WITH SHIELDING?	133b	
OTHER EXPOSURES		
40. DID YOU HAVE EXPOSURE TO DU THAT IS NOT CAPTURED BY THIS QUESTIONNAIRE? IF "NO," SKIP TO QUESTION 41. IF "YES," DESCRIBE ON THE FOLLOWING LINES:	134	

DEPLETED URANIUM QUESTIONNAIRE, Continued	SSN									

41. DO YOU HAVE OTHER EXPOSURES AND EXPERIENCES TO DISCUSS WITH THE PROVIDER? Code "Y" = Yes Code "N" = No IF "YES," DESCRIBE ON THE FOLLOWING LINES:	135	
42. IS THE 24-HOUR URINE COLLECTION FOR URANIUM BEING PERFORMED? Code "Y", Code "N," or Code "U" =Unknown. IF "NO" OR "UNKNOWN" PROVIDE EXPLANATION ON FOLLOWING LINES:	136	
43. DO YOU, THE VETERAN, CONSENT TO HAVING YOUR DATA SHARED WITH THE DEPARTMENT OF DEFENSE? Code "Y" = Yes or Code "N" = No.	137	
44. OTHER COMMENTS:		
45. NAME AND TITLE OF EXAMINER/REGISTRY PHYSICIAN (PRINT FULL NAME)		
46. SIGNATURE OF EXAMINER:		

Instructions: Once the DU questionnaire has been completed, VAMC RC will send a copy to AAC, with registry code sheet. If the veteran has already had a GW Registry examination, only the DU questionnaire will be sent to AAC. A copy of the questionnaire will also be sent to the DU Follow-up Program at the Baltimore VAMC with the package requesting the urine uranium test. The Baltimore DU Follow-up program staff will transmit the results of the urine uranium test directly to the AAC for database entry and to the VAMC of origin for entry into the veteran's medical record.

TO BE COMPLETED BY THE BALTIMORE VAMC FOLLOW-UP PROGRAM STAFF

47. CORRECTED URINE URANIUM (EXPRESSED PER MCG PER G CREATININE) 3 DIGITS TO THE LEFT AND 2 DIGITS TO THE RIGHT OF THE DECIMAL.	138-142	•
48. REPEAT URINE URANIUM	143-147	•
49. REMARKS:		

ATTACHMENT B

DEPLETED URANIUM PROGRAM CHECKLIST
24-HOUR URINE URANIUM COLLECTION
BALTIMORE VA MEDICAL CENTER

CONSULT URINE INSTRUCTIONS (REVISED 07/98)

PATIENT NAME: _____ **Social Security Number:** _____

ADDRESS : _____ **Specimen Date:** _____

_____

TELEPHONE: _____ **Date of Birth:** _____

Referring VA Medical Center: _____ **Mail Code:** _____

Address: _____

Referring Physician: _____

Beeper Number: _____ **Telephone Number:** _____

FAX Number (to receive report): _____

❒ Call DU Program at 1-800-815-7533 to obtain the specimen collection kit including the 24-hour specimen collection containers and shipping materials from DU Program. Only 32 oz Fischer Wide-mouth jugs will be accepted. Specimens received in any other container will be returned. Leaking containers will be returned.

❒ FAX a copy of this checklist with the top portion completed, and a completed copy of VA Form 10-9009D, Depleted Uranium (DU) Questionnaire, to 410-605-7943 PRIOR TO SENDING THE SPECIMEN.

❒ Schedule patient for 24-hour urine collection.

Date:_____

a. Time of first void (discarded) urine DAY 1:_____

b. Time of first void urine DAY 2:_____

DU PROGRAM CHECKLIST – CONSULT URINE INSTRUCTIONS (CONTINUED)

❒ Instruct patient to urinate directly into the collection container(s). Uranium sticks to the sides of the container. Therefore, do not transfer urine due to potential loss of analyte. Issue 3 containers to patient to insure full 24-hour collection in approved containers.

❒ Instruct patient to collect urine beginning after first morning void of Day 1 and end collection after first morning void on Day 2 (the next day).

❒ Seal containers as tightly as possible. Double bag each urine container with absorbent material. Make sure each plastic bag is sealed tightly. Stabilize container inside the box with more absorbent packing material to prevent movement. The sample should be mailed in the package provided. *TIP: YOU CAN CONTACT YOUR LABORATORY SERVICES SUPERVISOR TO ASSIST IN PACKAGING.*

❒ A copy of this form sealed in a separate Ziploc plastic bag should be enclosed with the sample for identification purposes and also faxed with the completed copy of VA Form 10-9009D to the DU office at 410-605-7943.

❒ SEND SPECIMEN VIA FEDEX. Call the DU Program Office at 800-815-7533 as soon as specimen has been shipped.

FED EX Tracking Number:_____

❒ SEND TO:

PATHOLOGY AND LABORATORY MEDICINE SERVICE (113)
BALTIMORE VA MEDICAL CENTER
10 N. GREENE STREET
BALTIMORE, MARYLAND 21201
ATTN: DR. LAWRENCE BROWN (FOR DU PROGRAM)

❒ Before sending this sample, call the DU program office at 1-800-815-7533 so that we can anticipate delivery. It is important that you fax a copy of this checklist, and a completed copy of VA Form 10-9009D to 410-605-7943.

❒ **You can expect notification of the results in approximately 45 days.**

ATTACHMENT C

SAMPLE OF REQUEST FOR AND CONSENT TO RELEASE OF INFORMATION FROM CLAIMANT'S RECORDS WITH OVERPRINT

Veterans Administration

REQUEST FOR AND CONSENT TO RELEASE OF INFORMATION FROM CLAIMANT'S RECORDS

NOTE: The execution of this form does not authorize the release of information other than that specifically described below. The information requested on this form is solicited under Title 39, United States Code, and will authorize release of the information you specify. The information may also be disclosed outside the VA as permitted by law to include disclosures as stated in the "Notices of Systems of VA Records" published in the Federal Register in accordance with the Privacy Act of 1974. Disclosure is voluntary. However, if the information is not furnished, we may not be able to comply with your request

TO	VETERANS ADMINISTRATION **Medical Center** **Washington, DC 20422**	NAME OF VETERAN *(TYPE OR PRINT)* **John O. Veteran**	
		VA FILE NO. *(Include prefix)* **C 12345678**	SOCIAL SECURITY NO. **100-200-3000**

NAME AND ADDRESS OF ORGANIZATION, AGENCY, OR INDIVIDUAL TO WHOM INFORMATION IS TO BE RELEASED

Department of Defense

VETERAN'S REQUEST

I hereby request and authorize the Veterans Administration to release the following information from the records identified above to the organization, agency, or individual named heron:

INFORMATION REQUESTED *(NUMBER EACH ITEM REQUESTED AND GIVE THE DATES OR APPROPRIATE DATE-PERIOD FROM AND TO- COVERED BY EACH.)*

1. **Gulf War Registry Examination results.**
2. **Depleted Uranium Questionnaire results.**
3. **Urine uranium results.**

PURPOSE FOR WHICH THE INFORMATION IS TO BE USED

Analysis of Depleted Uranium Surveillance Data.

NOTE: Additional items of information desired may be listed on the reverse hereof.

DATE	SIGNATURE AND ADDRESS OF CLAIMANT, OR FIDUCIARY, IF CLAIMANT IS INCOMPETENT

VA FORM 70-3288 JAN 1994 — EXISTING STOCKS OF VA FORM 70-3288 AN 70-3288. DEC 1976 WILL BE USED — U.S. GOVERNMENT PRINTING OFFICE : 1987 – 192-070 (406211)

APPENDIX 4a

Department of Veterans Affairs

Office of Media Relations
Washington, D.C. 20420
(202) 273-5700
www.va.gov

Fact Sheet

February 1999

NASOPHARYNGEAL RADIUM THERAPY

Radium was first used as a medical therapy in 1904. It was used internally and externally to treat a variety of diseases and conditions – from cancer to goiters to scalp ringworm. During the 1920s, a new technique was developed using radium to treat hearing loss in children caused by repeated ear infections (otitis media). This technique was called nasopharyngeal radium therapy.

What was nasopharyngeal radium therapy, who received it and what was its goal?

A radium-tipped rod was inserted in the nose and left for several minutes. Often, several treatments were provided in a series, each two to three weeks apart. The therapy also was used to treat sinusitis, tonsillitis, asthma, bronchitis, and repeated viral and bacterial infections. Because it was effective in treating otitis media, military physicians used it to treat aerotitis media in submariners, aviators and divers. Aerotitis media is hearing loss caused by swollen tissue in the throat combined with rapid pressure changes in the middle ear. The treatment was used to shrink tissue in the throat and prevent ear damage from pressure changes. An estimated 500,000 to two million civilians, mostly children, received these treatments. It is estimated that between 8,000 and 20,000 military personnel received them during World War II and until about 1960.

What were the advantages of the treatment?

It was used on tissues unsuitable for surgery, only local anesthesia was required, and it could be performed in a physician's office. The treatment also was believed to be safer than conventional X-ray treatment.

Why was it discontinued?

Pressurized aircraft cabins and new treatments, such as better antibiotics, as well as concerns about radiation safety resulted in its discontinuation.

Nasopharyngeal Radium Therapy – Page 2

Have nasopharyngeal radium treatments been shown to have harmful effects?

Several studies of the *possible* harmful effects of the treatment have been published. One study found an increased risk of head and neck cancer in people who were treated when they were children. Another study, also mostly of individuals treated as children, did not find any statistically significant increase in head and neck cancers. It is well known that children are more sensitive to the effects of radiation than adults. It is uncertain whether there are any health risks when adults are treated with nasopharyngeal radium. More research is being done, but it will take several years for answers from that research.

Are there any recommended actions?

A workshop of experts was held at Yale University in 1995 to help figure out what needed to be done for people who had received these treatments. The experts concluded that no special action should be recommended. They agreed that there are no screening tests for people who did not have symptoms of head or neck problems. However, physicians may want to consider conducting thorough head and neck examinations of patients with a history of these treatments. In addition, physicians who treat patients born before 1960 who have head and neck complaints should ask them if they have ever had these treatments or other head and neck radiation.

What should veterans do?

Veterans who remember being treated or think they were treated with nasopharyngeal radium should tell their physicians about it. Veterans who have health problems they think may be related to nasopharyngeal radium also are encouraged to contact the nearest VA medical center.

Public Law 105-368 enacted in November 1998 authorizes examinations and treatment of head and neck cancers for veterans who received nasopharyngeal radium treatments during active military, naval, or air service. For veterans not otherwise enrolled in VA health care, documentation of nasopharyngeal radium treatment in service records may be required to be eligible for these services. Veterans who are enrolled in VA health care receive medically indicated diagnostic and treatment services without any need to document exposures.

Information on filing a claim for disability compensation may be obtained by calling the nearest VA regional office at 1-800-827-1000. For questions on nasopharyngeal radium therapy, veterans may call VA's Public Health and Environmental Hazards Office at 1-202-273-8578. Questions on enrolling for VA health care may be directed to VA toll-free at 1-877-222-8387.

APPENDIX 4b

Department of Veterans Affairs
Veterans Health Administration
Washington, DC 20420

VHA DIRECTIVE 98-059

December 23, 1998

HEALTH SERVICES FOR VETERANS TREATED WITH NASOPHARYNGEAL (NP) RADIUM DURING ACTIVE MILITARY, NAVAL, OR AIR SERVICE

1. PURPOSE

This Veterans Health Administration (VHA) Directive outlines the policy and procedures for providing health services to veterans treated with nasopharyngeal (NP) radium irradiation during active military, naval, or air service.

2. BACKGROUND

a. During the 1920s, a new technique was developed using radium to treat hearing loss caused by repeated ear infections. This technique was called nasopharyngeal (NP) radium therapy. Radium-tipped rods were inserted into the nostrils and left in place for several minutes. The treatments frequently were repeated at intervals of several weeks. NP radium treatments were used for other conditions including sinusitis, tonsillitis, asthma, bronchitis, and repeated viral and bacterial infections. It is estimated that half a million to two million civilians, mostly children, received these treatments.

b. Because it was effective in treating otitis media, military physicians used NP radium to treat aerotitis media (barotrauma) in submariners, aviators, and divers due to enlarged tissue in the throat combined with rapid pressure changes. It is estimated that between 8,000 and 20,000 military personnel received NP radium treatments during World War II and until the 1960s.

c. Several studies of the possible harmful effects of NP radium treatments have been published. One study found an increased risk of head and neck cancer in people who were treated as children. Another study, mostly of individuals treated as children, did not find any statistically significant increase in head and neck cancers. It is well known that children are more sensitive to the effects of radiation than adults. Additional follow-up research studies are pending.

d. A workshop on public health issues associated with NP radium treatments was held at Yale University in 1995. No screening tests for asymptomatic individuals were recommended.

e. Recently Public Law 105-368 was enacted authorizing care and services limited to examinations and treatment of head and neck cancers for veterans who had received NP radium treatments during active military, naval, or air service.

3. POLICY

Each VHA facility will provide care and services to veterans treated with NP radium during active military, air and naval service, as authorized by Public Law 105-368.

4. ACTIONS

Facility Directors will ensure that the following actions are taken with respect to veterans treated with NP radium in service.

a. **Determination of Eligibility.** To be eligible under this authority, a veteran must have (1) documentation of NP radium treatment in active military, naval, or air service, (2) have served as an aviator in the active military, naval, or air service before the end of the Korean conflict or (3) undergone submarine training in active naval service before January 1, 1965. Eligible veterans may receive services shown in subparagraphs 4b and 4c whether or not they are enrolled for Department of Veterans Affairs (VA) healthcare.

b. **Examinations**

(1) Veterans with head or neck complaints or who are concerned about possible adverse effects of their NP radium treatments will be offered the opportunity to receive an Ionizing Radiation Registry (IRR) examination (M-10, Part II, March 30, 1992). ***NOTE:*** *The IRR (1987) code sheet is being modified so that the veteran's treatment with NP radium in service can be indicated. In the interim, if a facility should provide an IRR examination before this code sheet is modified, indicate under the "Remarks" section (Item 19) whether or not the veteran had NP treatment.*

(2) Examination by an ear, nose, and throat (ENT) specialist and additional studies, such as biopsies, will be performed if clinically indicated.

c. **Treatment of Head or Neck Cancer.** Eligible veterans will be offered treatment, including hospital care, medical services, and nursing home care, for any cancer of the head or neck which may be associated with the receipt of nasopharyngeal radium irradiation treatments, regardless of their enrollment priority group or enrollment status.

d. **Provision of Other Services.** Provision of other services to these veterans in addition to examinations and treatment of head or neck cancers will be dependent on their other eligibilities (e.g., whether or not they are enrolled for VA care).

5. REFERENCES

a. Dale P. Sandler, George W. Comstock, and Genevieve M. Malanoski, "Neoplasms Following Childhood Radium Irradiation of the Nasopharynx," Journal of the National Cancer Institute, Vol. 68, No. 1, January 1982, pages 3-8.

b. Peter G. Verduijn et al., "Mortality After Nasopharyngeal Radium Irradiation For Eustachian Tube Dysfunction," Annals of Otology, Rhinology and Laryngology, Vol. 98, 1989, pages 839-844.

c. Jan A. Stolwijk and Audrey F. Saftlas, "The Public Health Response to Nasopharyngeal Radium Irradiation: A Workshop," Otolaryngology – Head and Neck Surgery, Vol. 115, 1996, pages 387-446.

6. FOLLOW-UP RESPONSIBILITIES

The Chief Public Health and Environmental Hazards Officer (13) is responsible for the contents of this directive. Questions should be addressed to the Office of Public Health and Environmental Hazards at 202-273-8575.

7. RESCISSION

This VHA Directive expires December 23, 2003.

S/ by Melinda Murphy for
Kenneth W. Kizer, M.D., M.P.H.
Under Secretary for Health

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THIS VHA DIRECTIVE EXPIRES DECEMBER 23, 2003

APPENDIX 5

Excerpt from, VA Manual M21-1, Part III, Chapter 5, Change 74, April 30, 1999

BRANCH OF SERVICE RECORD

Each branch of service maintains a record of occupational radiation exposure. If a service record of occupational exposure to ionizing radiation (i.e. DD Form 1141 which was superceded by NAVMED 6470/10 and 6470/11 for the Navy, or the equivalent NRC Form 5) is not found prepare a written request to the appropriate branch of service. The request will contain identifying data as required by subparagraph 5.12d(3)(a) through (g) including claimant's name, address, phone number, date and place of birth, file number, social security number, service number, period of service, and the nature of the disability. The addresses for the branches of service are:

Air Force:
Air Force Medical Operations Agency
AFMOISGOR
Radiation Protection Division
110 Luke Avenue, Room 4005
Bolling Air Force Base
Washington, DC 20332-7050
Telephone 202-767-4309, ext 360

Army:
Army Radiation Standards and Dosimetry Laboratory
Dosimetry Branch
Attn: AMSAM-TMD-SR-D
Bldg 5417
Redstone Arsenal, Al 35898-5000
Telephone 205-876 1786

Navy and Marines:
Officer in Charge
Navy Environmental Health Center Detachment
Naval Dosimetry Center
Bethesda, MD 20559-5614
Telephone 301-295-5426

Coast Guard:
Commandant
US Coast Guard (WKS-3)
Attn: Occupational Health Physician
Washington, DC 20593-0001
Telephone 202-267-1883

In instances where military personnel were attached to Atomic Energy Commission Laboratories during the testing period and were badged by the AEC facility the Department of Energy central records repository should be included as part of a comprehensive radiation records search. The addresses are:

US Department of Energy
Bechtel Nevada
Coordination and Information Center
2601 Losee Road
North Las Vegas NV 89030-4134
Telephone: 702-295-0748

US Department of Energy
EH-52
Attn: Nimi Rao
19901 Germantown Rd.
Germantown, Md. 20874
Telephone: 301-903-2297

Reference: M21-1, Part III Change 74
April 30, 1999

ADDENDUM

The Program Manager, Medical Health Physics Program, US Army Center for Health Promotion and Preventive Medicine (USACHPPM), 5158 Blackhawk Rd., Aberdeen Proving Ground, MD 21010-5422, telephone 410-436-3548, also may be able to assist in providing radiation dose estimates for some veterans.

APPENDIX 6

From For the Record – A History of the Nuclear Test Personnel Review Program, 1978-1993, by F. Gladeck and A. Johnson, Defense Nuclear Agency, DNA 6041F, March 1996.

SECTION 5
THE ATOMIC BOMBINGS AND U.S. OCCUPATION OF HIROSHIMA AND NAGASAKI

The United States had two atomic bombs ready for use in early August 1945. They were both dropped on Japan, the first over Hiroshima on 6 August 1945 and the second over Nagasaki on 9 August. The Hiroshima weapon was smaller, with a yield of about 15 kilotons compared to the 21 kilotons for the Nagasaki detonation. They were both air bursts, detonated at about 1,670 and 1,640 feet, respectively. These burst heights were chosen to maximize blast damage and to minimize residual radiological contamination.

The objective of the bombings was to bring World War II to a quick end, thereby avoiding the death and destruction that would inevitably result from the planned invasion of the Japanese home islands. During the U.S. invasion of Okinawa, 1 April through 21 June 1945, the U.S. casualties included about 12,000 killed, and the Japanese loses approached 100,000 killed. On 26 July 1945, President Harry Truman urged the Japanese to surrender unconditionally or face "prompt and utter destruction." The Japanese ignored the warnings, having heard similar predictions before fire raids. Subsequently, they lost more than 75,000 people in Hiroshima and more than 35,000 in Nagasaki. On 2 September 1945, Japan officially surrendered to Allied forces. The early radiation surveys and the American occupation of Hiroshima and Nagasaki followed shortly thereafter.

5.1 EARLY RADIATION SURVEYS

In the months immediately following the detonations, U.S. scientists conducted a number of onsite surveys to he sure that any residual radiation in Hiroshima and Nagasaki would not present a health hazard to occupation troops or to the Japanese remaining in the cities. General Marshall, U.S. Army Chief of Staff in Washington, addressed the first concern in a message sent to General MacArthur, the Theater Commander. General Marshall emphasized the importance of early radiation surveys so that the occupation troops "shall not be subjected to any possible toxic effects, although we have no reason to believe that any such effects actually exist." Three series of early radiation surveys followed:

- Scientists from the Manhattan Engineer District (MED), the organization that had developed the bombs, made rapid radiation surveys of Hiroshima on 8 and 9 September 1945 (one month before occupation troops arrived in that area) and of Nagasaki on 13 and 14 September (10 days before the occupation troops arrived).

  - They reported negligible levels of radioactivity in the areas surveyed (Farrell, 1977).

- The Manhattan Project Atomic Bomb Investigating Group made more extensive surveys in Nagasaki from 20 September to 6 October and in Hiroshima from 3 to 7 October 1945.
  - Their measurements, showed the levels of residual radioactivity to be extremely low (Tybout, 6 April 1946).

- The Naval Technical Mission to Japan surveyed Nagasaki during 15 to 27 October 1945 and Hiroshima on 1 to 2 November 1945 (Pace and Smith, 16 April 1946).
  - Their findings of negligible levels of radioactivity corroborated the earlier measurements.

In addition to these surveys, the U.S. investigation teams used data from numerous separate radiation monitoring surveys, soil and debris sampling programs, and other analyses conducted by Japanese scientists after the bombings.

The initial and rapid measurements taken by the MED served the critically important purpose of allowing the American occupation of Hiroshima and Nagasaki to proceed as scheduled. The more extensive surveys by the Manhattan Project Atomic Bomb Investigating Group and the Naval Mission to Japan resulted in reports since regarded as basic source documents and listed in **Appendix G**.

5.2 RESIDUAL RADIATION IN HIROSHIMA AND NAGASAKI.

After the bombings, two areas of low-level residual radioactivity remained in each city: An area of induced radioactivity around ground zero and a downwind area contaminated by rainout/fallout.

5.2.1 INDUCED RADIOACTIVITY AT THE HYPOCENTERS.

Roughly circular patterns of residual radiation were created at the times of detonation, when the high-intensity burst of neutrons from the bomb encountered elements in the soil and building materials, such as concrete, metal, and tile, in the area beneath the detonation and caused them to become radioactive. (Examples of elements in which radioactivity can be induced are aluminum, sodium, manganese, cobalt, scandium, and cesium). The induced radioactivity decreased rapidly since many of the radionuclides produced in this manner had short half-lives (the time required for the radiation intensity to be reduced from any given value to one-half that value). For example, aluminum-28 has a half-life of about 2.3 minutes, and manganese-56 has a half-life of about 2.6 hours.

Figures 5.1 and 5.2 clearly illustrate the area of neutron-reduced radioactivity around the hypocenter ground zero [GZ] in each city as of the radiological survey dates indicated. By the time of occupation force arrival (23 September 1945 at Nagasaki; 7 October 1945 near Hiroshima) the radiation intensity at the hypocenter had decayed to very low levels (0.1 milliroentgen* per hour or less) and the area of measurable radioactivity had diminished to within about one mile from GZ. It should also be noted that the radioactivity was well within the area of almost total destruction.

5.2.2 RADIOACTIVITY DOWNWIND OF THE CITIES.

As the radioactive cloud moved downwind from the center of each city, rain showers within the hour after the detonation caused some of the fission products and unfissioned residue of the bomb to be carried to earth in a manner similar to fallout. This "rainout" produced a small pattern of radioactivity on the west side of Hiroshima, near Takasu; and a somewhat larger area east of Nagasaki, with peak levels in the vicinity of the Nishiyama Reservoir.

Figures 5-1 and 5-2 show the areas and intensities of residual radioactivity caused by the rainout/fallout. Of the four patterns of measurable residual radioactivity remaining in and around the two cities upon the arrival of the occupation troops, the most significant was in the vicinity of the Nishiyama Reservoir outside Nagasaki, indicated in Figure 5-2. A peak intensity of about one milliroentgen per hour was measured near the reservoir about the time of the troop arrival. The terrain in the area was rugged, characterized by steep slopes and heavy vegetation, with few trails or roads and even fewer buildings. The Japanese population was sparse, and there was little need for occupation force presence in the area.

The small rainout pattern west of Hiroshima, had a peak intensity of about 0.05 milliroentgen per hour when the occupation troops reached this part of Japan.

By the time of the occupation, the intensity of the radioactivity (mixed fission products) caused by rainout had dropped to less than a thousandth of the intensity one hour after the detonation. The main reason for this was the rapid overall decay of fission products. In general, the radioactivity one hour after a detonation (H+1) will decay to one-tenth its former level within the next seven hours. Two days after the detonation, the radiation intensity would have dropped to about one-hundredth of its H+1 value. Two weeks after the detonation, the intensity would have decayed to about one-thousandth of its H+l value.

**A milliroentgen equals one-thousandth of a roentgen*

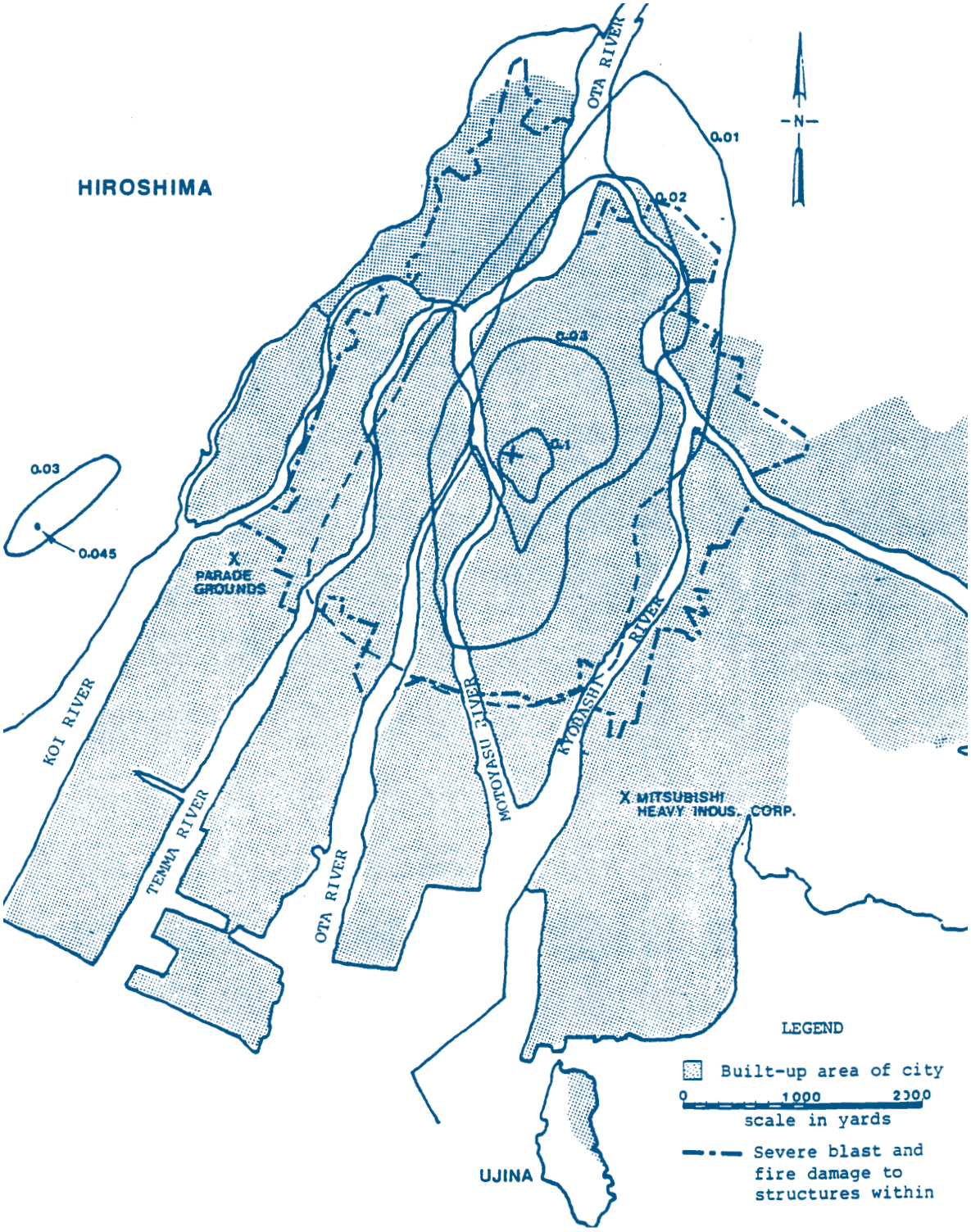

Figure 5-1. Manhattan Engineer District Survey of Hiroshima, Japan, 3-7 October 1945.

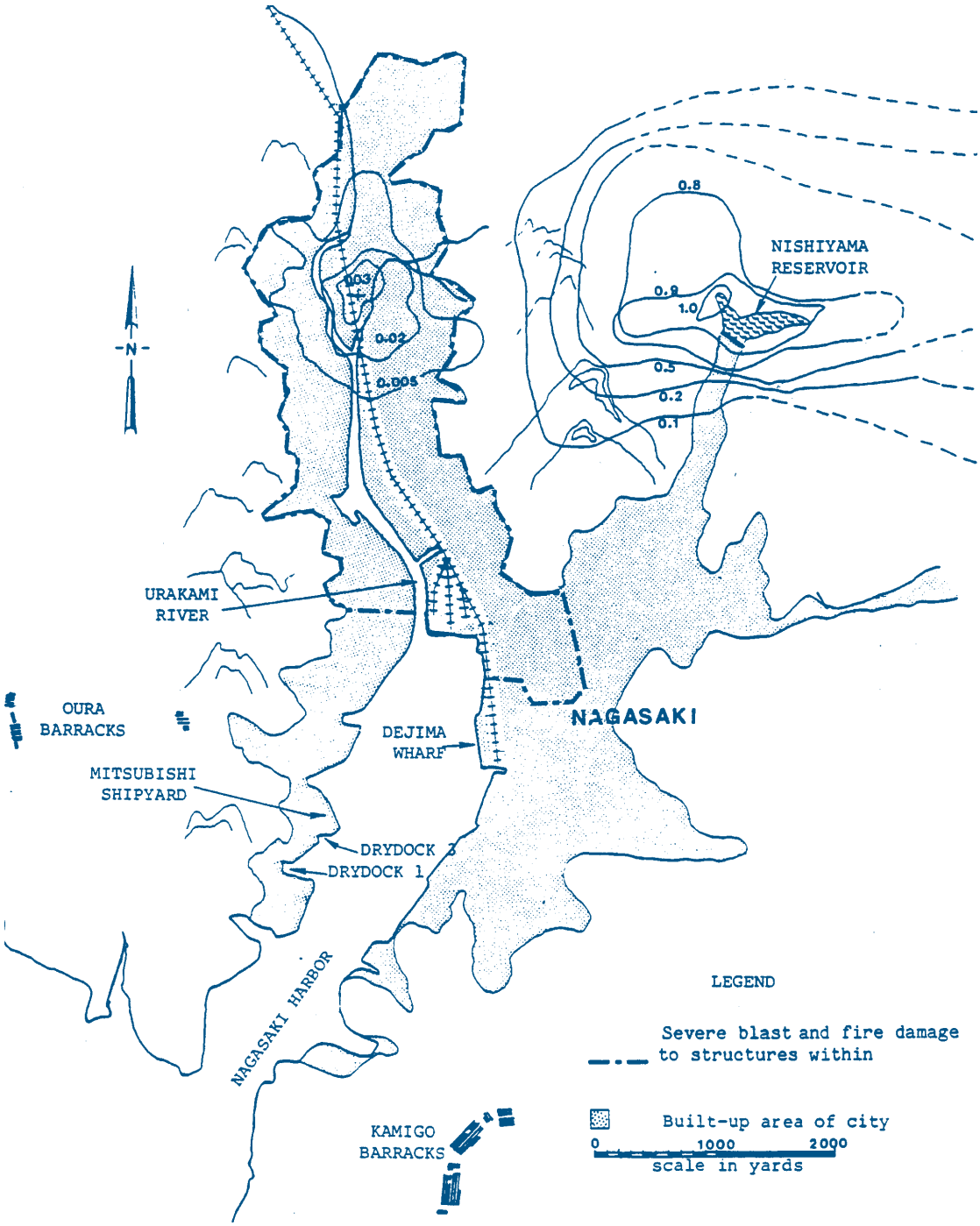

Figure 5-2. Manhattan Engineer District Survey of Nagasaki, Japan,
21 September - 4 October 1945.

The reduction of radioactivity was aided by heavy rains during autumn 1945 that washed away some of the residual radiation. Between the bombings and the start of the occupation, approximately 62 centimeters (24 inches) of rain fell in Hiroshima and 82 centimeters (32 inches) in Nagasaki. The heavy rainfall continued during the occupation and by 1 November the cumulative total since the bombing was 91 centimeters (36 inches) in Hiroshima and 122 centimeters (48 inches) in Nagasaki.

5.3 OCCUPATION OF JAPAN.

The occupation of the western portion of Honshu Island (which contains Hiroshima), the southern Japanese islands of Kyushu (where Nagasaki is located), and Shikoku, was the responsibility of the Sixth U.S. Army, consisting of the I and X Army Corps and the V Amphibious Corps (Marines). Each Corps had three divisions and supporting units. The occupation force for this portion of Japan totaled some 240,000 troops. The Army had primary responsibility for the occupation of Hiroshima and the Marine Corps had primary responsibility for the occupation of Nagasaki.

The mission of the occupation troops was to establish control of the home islands of Japan, ensure compliance with the surrender terms, and demilitarize the Japanese war machine. The duties did not include the “cleanup” of Hiroshima, Nagasaki, or any other areas, nor the rebuilding of Japan.

5.3.1 HIROSHIMA OCCUPATION.

Two divisions, both part of X Corps of the Sixth Army, accomplished the occupation of the area in the immediate vicinity of Hiroshima:

41st Division, 7 October 1945 to December 1945

24th Division, December 1945 to 6 March 1946, when the U.S. occupation of Hiroshima came to an end.

The occupation troops landed at Kure, about nine miles southeast of Hiroshima. One of the first actions carried out by the 186th Infantry Regiment, 41st Division was to set up a roadblock in the vicinity of Kaidaichi to prevent entry into Hiroshima by military personnel. Units of the two divisions were billeted in barracks, rehabilitated buildings, hotels, and private residences in Kure, Hiro, Ujina, Tenno, Eta Jima, Koyaura and Kaidaichi (all within 10 miles of the city limits of Hiroshima). With the possible exception of a few troops supporting scientific groups, none of the occupation forces were billeted within the city limits of Hiroshima.

Units of the 186th Infantry Regiment, 41st Division, conducted reconnaissance patrols and other specific daily assignments throughout their area of responsibility, which included the city of Hiroshima. It is assumed that individuals of the regiment made occasional patrols into the destroyed area of the city and that individuals from nearby units of the 41st Division may have made brief sightseeing trips into the area. Radiation doses received by these participants and the other occupation troops are summarized in Section 5.4.

5.3.2 NAGASAKI OCCUPATION.

While the Hiroshima occupation primarily involved Army troops, the occupation of Nagasaki consisted mostly of Marine Corps units, with small supporting Navy and Army elements.

Responsibility for the Nagasaki area was assigned to the 2nd Marine Division, a unit of the V Amphibious Corps. During the first three months of the occupation, Division strength in Nagasaki is estimated at approximately 10,000 troops. Division strength averaged about 5,000 to 7,000 for the next three months, through February 1946, and 3,000 to 4,000 for the last four months of the occupation, through 30 June 1946.

Three units of the 2nd Marine Division had key roles during various periods of the occupation, as indicated below:

- 2nd Regimental Combat Team (RCT-2), 23 September to early November 1945. The zone of occupation included the east side of the Nagasaki Harbor and most of the nearby county east of the Urakami River.
- RCT-6, 23 September to December 1945. The zone of occupation included the west side of the Nagasaki Harbor and most of the nearby county west of the Urakami River.
- 10th Marine Regiment, November 1945 to June 1946, when the Marine Corps occupation of Nagasaki came to an end. The Regiment assumed the responsibilities of RCT-2 and RCT-6 upon their departure from Japan.

Specific billet locations have not been identified for all division units, which also included the 8th RCT, a Headquarters Battalion, Service Troops, an Engineer Group, a Tank Battalion, an Observation Squadron, and some smaller organizations. It is known, however, that RCT-2 was billeted in the Kamigo barracks and RCT-6 in the Oura barracks, both shown in Figure 5-2. The other troops also were billeted in areas well clear of the hypocenter, which was cordoned off.

Five companies of the Army's 34th Infantry Regiment moved to Nagasaki and Omura during the last 10 days of June 1946. Approximately 25,000 Marines and 2,000 Army personnel participated in the occupation of Nagasaki.

Section 5.4 summarizes doses for Nagasaki participating personnel.

5.4 RADIATION DOSES.

Few world events have been as thoroughly documented at the time, and as intensively and continuously studied since, by as many different groups of scientists as the atomic bombings and related radiation exposures at Hiroshima and Nagasaki. Thus, the patterns of residual radiation are well understood. This understanding, with other information, provides a solid basis for radiation dose determination.

The extensive radiation measurements and soil sample analyses taken by numerous Japanese and U.S. scientists in the weeks following the bombings are still available. These results and subsequent radiation measurements and sampling have formed the basis for intensive research over the past 48 years by Japanese and U.S. scientists of every aspect of the bombings and the radiation after effects. The Japanese Government and the American NAS have stimulated, supported, and advanced this research.

Documentation of the U.S. occupation of Japan is voluminous in Army, Navy, and Marine Corps archives. Unfortunately, however, no central listing of participating units exists. Consequently, to meet the requirements of Public Law 100-321 (see Section 3.3.2), extensive research has been required to determine which units were present, when they arrived, where they were stationed, what their missions were, and when they left.

In spite of the still-existing gaps in unit data, detailed technical dose reconstructions have determined the maximum possible radiation doses that might have been received by any participant. Section 8, Radiation Dose Determination, addresses this process, explaining the "worst case" analysis used to identify the highest possible dose. Using all possible "worst case" assumptions, the maximum possible dose any occupation force member might have received from external radiation, inhalation, and ingestion is less than one rem. This does not mean that any individual approached this exposure level. In fact, it is probable that the great majority of personnel assigned to the Hiroshima and Nagasaki occupation forces received low radiation exposures and that the highest dose received by anyone was a few tens of millirem.

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HIROSHIMA AND NAGASAKI OCCUPATION FORCES

Overview

Atomic bombs were detonated over Hiroshima and Nagasaki, Japan, on Aug. 6 and Aug. 9, 1945, respectively. Following the surrender of Japan on Aug.14, 1945, U.S. forces began occupying the country.

The first occupation troops arrived in the vicinity of Hiroshima about 60 days after the bombing. The main body of occupation troops entered Nagasaki about 45 days after the bombing. In each city, a group of American scientists arrived three days before these troops and performed a radiological survey. However, repatriation of former prisoners of war (POWs) through Nagasaki began before the survey and actual occupation of the city.

U.S. troops were in the vicinity of Hiroshima between Oct. 6, 1945, and March 6, 1946, and in the vicinity of Nagasaki principally between Sept.11, 1945, and July 1, 1946.

The mission of the occupation was to establish control of the area, ensure compliance with surrender terms, and demilitarize the Japanese war machine. The mission did not include the cleanup or any radiological decontamination of Hiroshima, Nagasaki, any other areas, or the rebuilding of Japan.

Initial units involved

- Hiroshima – 186th Infantry Regiment of the 41st Division, X Corps of the Sixth Army; later replaced by the 34th Infantry Regiment of the 24th Division.
- Nagasaki – 2nd Marine Division, which included the 2nd, 4th, and 8th Regimental Combat Teams (RCTs) and an Artillery Group composed principally of the 10th Marine Regiment. Other units of the 2nd Marine Division involved were a Headquarters Battalion, Service Troops, an Engineer Group, a Tank Battalion, an Observation Squadron and some smaller organizations.

Troops were constantly on the move and changing assignments during the occupation, and the duration of assignment for any unit in the occupation forces was quite short. Men with the longest service periods were given priority for transfer home and whole units were deactivated as it became apparent that large numbers of troops were not necessary to fulfill the mission. The size of the occupation force dropped sharply every month.

The total number of troops occupying Hiroshima was about 40,000. Approximately 27,000 troops occupied Nagasaki. About 12,000 troops occupied outlying areas within 10 miles of either city through July 1, 1946. An additional 118,000 servicemen had passed through these areas by July 1, 1946. These transient personnel included POWs, troops disembarked for elsewhere in Japan and crews of ships docked nearby.

Refer to Title 38, Code of Federal Regulations (38 CFR), part 3.309(d)(3) for the context of the following extracted formal VA definitions of occupation forces and POWs.

> ***Occupation force***. *The occupation of Hiroshima or Nagasaki, Japan, by United States forces during the period beginning on August 6, 1945, and ending on July 1, 1946.*
>
> ***POW:*** *Internment as a prisoner of war in Japan (or service on active duty in Japan immediately following such internment) during World War II which resulted in an opportunity for exposure to ionizing radiation comparable to that of the United States occupation forces in Hiroshima or Nagasaki, Japan, during the period beginning on August 6, 1945, and ending on July 1, 1946.*
>
> *The term "occupation of Hiroshima or Nagasaki, Japan, by United States forces" means official military duties within 10 miles of the city limits of either Hiroshima or Nagasaki, Japan, which were required to perform or support military occupation functions such as occupation of territory, control of the population, stabilization of the government, demilitarization of the Japanese military, rehabilitation of the infrastructure or deactivation and conversion of war plants or materials.*
>
> *Former prisoners-of-war who had an opportunity for exposure to ionizing radiation comparable to that of veterans who participated in the occupation of Hiroshima or Nagasaki, Japan, by United States forces shall include those who, at any time during the period August 6, 1945, through July 1, 1946:*
>
> *(A) Were interned within 75 miles of the city limits of Hiroshima or within 150 miles of the city limits of Nagasaki, or*
> *(B) Can affirmatively show they worked within the areas set forth in (A) although not interned within those areas, or*

(C) Served immediately following internment in a capacity which satisfies the above definition of occupation forces, or
(D) Were repatriated through the port of Nagasaki.

Occupation scenario

Hiroshima. Elements of the 41st Division landed at Hiro, approximately 10 miles southeast of Hiroshima, on Oct. 6, 1945, and secured the Kure Naval Yard. On Oct. 7, the 186th Infantry Regiment of the 41st Division landed, and the Regiment's 2nd Battalion established headquarters and billets in Kaidaichi, about 5 miles southeast of the center of Hiroshima. Since most of the city of Hiroshima had been destroyed by the bomb (see Figure 1), no major units were stationed there throughout the occupation. During the next two months, units of the 186th Infantry Regiment conducted reconnaissance patrols and other missions in its area of responsibility, including the city of Hiroshima. Records indicate that troops occasionally patrolled the destroyed area of the city. Additionally, individuals from nearby units of the 41st could have made brief sightseeing trips to view the destruction caused by the bomb. About 900 U.S. POWs were repatriated through Hiroshima.

Upon deactivation of the 41st Division in December 1945, the 34th Infantry Regiment of the 24th Division took over its mission and moved into the buildings in Kaidaichi originally used by units of the 186th. The 34th Regiment was responsible for such a wide geographic area that eventually only Company G of the 2nd Battalion was stationed in the vicinity of Hiroshima. On March 6, 1946, the 34th Regiment was relieved by an Australian Infantry Battalion, and the U.S. occupation in the vicinity of Hiroshima ended.

Nagasaki. Nagasaki was used to repatriate former POWs because the waterfront was sufficiently far from the hypocenter (the spot on the ground directly under the detonation, i.e., ground zero) to have escaped most of the destructive effects of the bomb, and to have been completely free of radioactivity (see Figure 2). Over 9,000 allied (including 2,300 U.S.) POWs were processed at Nagasaki Sept. 11-23, 1945. A POW recovery team and a detachment of Marine guards were ashore in Nagasaki to support POW processing. Additionally, a small advance party of the occupation force (about 12 personnel) arrived in Nagasaki on Sept.16, 1945, and remained until the main force arrived on Sept. 23, 1945.

Upon landing, the 8th RCT and the 10th Marines deployed immediately to Isahaya, about 10 miles north of Nagasaki. The 8th RCT did not occupy Nagasaki, but the 10th Marines did so two months later. The other elements of the 2nd Marine Division debarked in the vicinity of Dejima Wharf and the Mitsubishi shipyard and established command posts and billets in those vicinities. The 2nd RCT left Nagasaki in early November, and the

6th RCT departed in December 1945 along with two-thirds of the Engineer Group. The Headquarters Battalion and portions of the Service Troops left Nagasaki in January 1946. The Tank Battalion, which had landed and remained in Fukahori, about nine miles south-east of Nagasaki, arrived in Nagasaki in November 1945 and departed the next month. The 10th Marines took over the responsibilities of the 2nd RCT in November, and later also those of the 6th RCT. The last units of the 2nd Marine Division left Nagasaki on July 1, 1946.

The specific billet locations of all units have not been precisely determined, but they were undoubtedly outside of the radiation survey contours surrounding the hypocenter in Figure 2. An area extending beyond those contours was uninhabitable because of complete destruction, and historical documents confirm that the area was avoided. As with Hiroshima, presumably patrols and sightseers occasionally entered the areas of residual contamination in Nagasaki. The U.S. Navy transported Marines to Nagasaki and evacuated POWs, but its role ashore was limited. Some Navy personnel, including hospital corpsmen, medical and dental officers, chaplains, and a construction battalion, were assigned to the 2nd Marine Division.

Radiation data

Analysis of the scientific data for the Hiroshima and Nagasaki airbursts continues, resulting in revised statistics for the detonations. The Hiroshima bomb was uranium-235 weapon that detonated about 1,900 feet above the ground with a yield of 15 kilotons (kT). The Nagasaki bomb was a plutonium-239 weapon that detonated 1,650 feet above the ground with a yield of 21 kT. Figures 1 and 2 show the built-up areas of the respective cities, the hypocenter of each burst, residual gamma radiation intensity contours, and the approximate perimeters of total destruction from blast and fire.

The radiological effects of the detonation in each city were similar. Japanese citizens in the vicinity at the time of the detonations were exposed to intense radiation produced almost instantaneously. High doses of hundreds of rem from this initial neutron and gamma radiation contributed to the lethality of Japanese citizens located beneath the bursts. This initial radiation only occurs for about one minute after a nuclear detonation and does not persist thereafter. In contrast, the earliest residual radiation levels encountered by Japanese were survivable. Both burst altitudes were sufficiently high that bomb debris did not reach the ground in the vicinity of the hypocenter. After the detonations, strong updrafts were produced which lifted the radioactive bomb debris, ground dust and smoke together in clouds. Most of the mixed debris settled to the ground as radioactive fallout downwind of the cities. In each city, there was one area of low-level residual radioactivity

in a roughly circular area caused by neutron activation of soil and building materials around the hypocenter. Additionally, there was a second area of residual radioactivity located downwind and outside the city, caused by fallout carried to the ground during rain shower activity within an hour after the detonation. Subsequent heavy rainfall washed away some of the residual radioactivity. During the intervening weeks before the occupation forces arrived, this rainfall, combined with radiological decay, reduced the radiation levels from fallout and neutron-activated materials by a factor of several thousand. This explains, in part, why the radiation doses of occupation forces were at least a thousand times lower than those Japanese located near ground zero at the time of the detonation.

Based on radiation surveys by American scientists from the Manhattan Engineer District, the greatly decayed residual radioactivity levels in and around Hiroshima and Nagasaki at the time the occupation forces arrived were such that military activities could proceed as planned, unimpeded by radiological considerations.

Figure 1 depicts the results of the Naval Medical Research Institute survey taken in Hiroshima on Nov. 1-2, 1945, showing a residual radiation level of 0.069 milliroentgen per hour (mR/hr) at ground zero, and an average residual radiation level of 0.011 mR/hr in the area of rainout to the west of the city.

Figure 2 depicts the results of the Naval Medical Research Institute survey taken in Nagasaki on Oct. 15-27, 1945, showing the residual radiation level of 0.072 mR/hr (maximum) at ground zero, and a residual radiation level of up to 1.08 mR/hr in the rain-out area at the Nishiyama Reservoir. Scientific analysis of these data indicated that two radionuclides, scandium-46 and cobalt-60, which resulted from neutron activation of surface soil and building materials, produced the radiation levels near ground zero in each city. Fission product radionuclides produced the radiation levels in the rainout areas.

The Nishiyama Reservoir had the highest radiation measurement recorded at the time of the troops' arrival. However, this area was remote and rugged, with steep slopes and heavy forests, few trails or roads, and even fewer buildings. The Japanese population in the area was sparse, so there were no occupation forces stationed in the vicinity, and little need for military patrols into the area.

Personnel doses

Dose reconstructions are based on (1) residual radiation measurements, documented and published shortly after the bombings, (2) extensive review and analysis of the residual radioactivity in ensuing decades, and (3) the documented arrival and departure dates of each military unit which operated in the vicinity of Hiroshima and Nagasaki.

Using the "worst case" assumptions that lead to the highest radiation dose consistent with a military unit's potential for exposure, the dose reconstructions show that the maximum total* radiation dose any member of the U.S. occupation forces in Japan could have received was less than 1 rem.** The average dose received by individuals in the Hiroshima and Nagasaki occupations was less than 0.01 rem. More than 95 percent of all Hiroshima and Nagasaki participants received a dose less than 0.1 rem, which is the annual radiation dose limit for the U.S. general public currently in effect.

Similar dose reconstructions indicate that U.S. servicemen who survived imprisonment in Japanese camps received virtually no radiation dose, with the exception of the POWs held in the camp at Kumamoto. Fallout was detected in this city downwind of Nagasaki.

The range of total doses for occupation forces, POWs, and transient personnel is:

Category of Defined Participants	Percentage of Defined Participants	Probable Dose (rem)	Maximum Dose (rem)
Occupation forces – Nishiyama area and POWS – Kumamoto Camp	4%	<0.1	<1
Other Hiroshima/Nagasaki occupation forces	36%	<0.01	<0.1
Naval ship crews	43%	0.0	<0.01
Disembarked troops (for elsewhere in Japan)	13%	0.0	<0.01
Transients on railroads	2%	0.0	<0.01
Repatriated POWs	2%	0.0	<0.01

These doses are in contrast to the reconstructed initial radiation doses, which ranged between about 10 rem to hundreds of rem for the hundreds of thousands of Japanese survivors whose health continues to be monitored by the Radiation Effects Research Foundation (RERF). The RERF (formerly known as the Atomic Bomb Casualty Commission) members are officials from the Japanese Department of Health and the American National Academy of Sciences. For further information on these studies contact:

Director, Board on Radiation Effects Research
National Academy of Sciences
(Room 342)
2101 Constitution Avenue, NW
Washington, D.C. 20418

For additional information on the RERF, contact the Director of the Board on Radiation Effects Research, telephone (202) 334-2836, or visit the RERF's Internet site (**http://www.rerf.or.jp/eigo/experhp/rerfhome.htm**).

* *Sum of external and internal dose, where internal dose is the 50-year committed effective dose equivalent.*

** *A rem is a unit that quantifies the biological effect of ionizing radiation (gamma, x-ray, beta, neutron or alpha) on man. Ionizing radiation is any radiation capable of displacing electrons from atoms or molecules, thereby producing ions. The general U.S. population receives about 0.36 rem per year (National Council on Radiation Protection and Measurements (NCRP), Report No.93, Table 8.1) from natural background radiation sources (radon, cosmic rays and rocks) and man-made radiation sources (medical diagnostic x-rays and consumer products). The standard diagnostic chest x- ray delivers a dose of about 0.02 rem. For more information about NCRP Report 93, contact the NCRP Internet site (**http://www.ncrp.com**).*

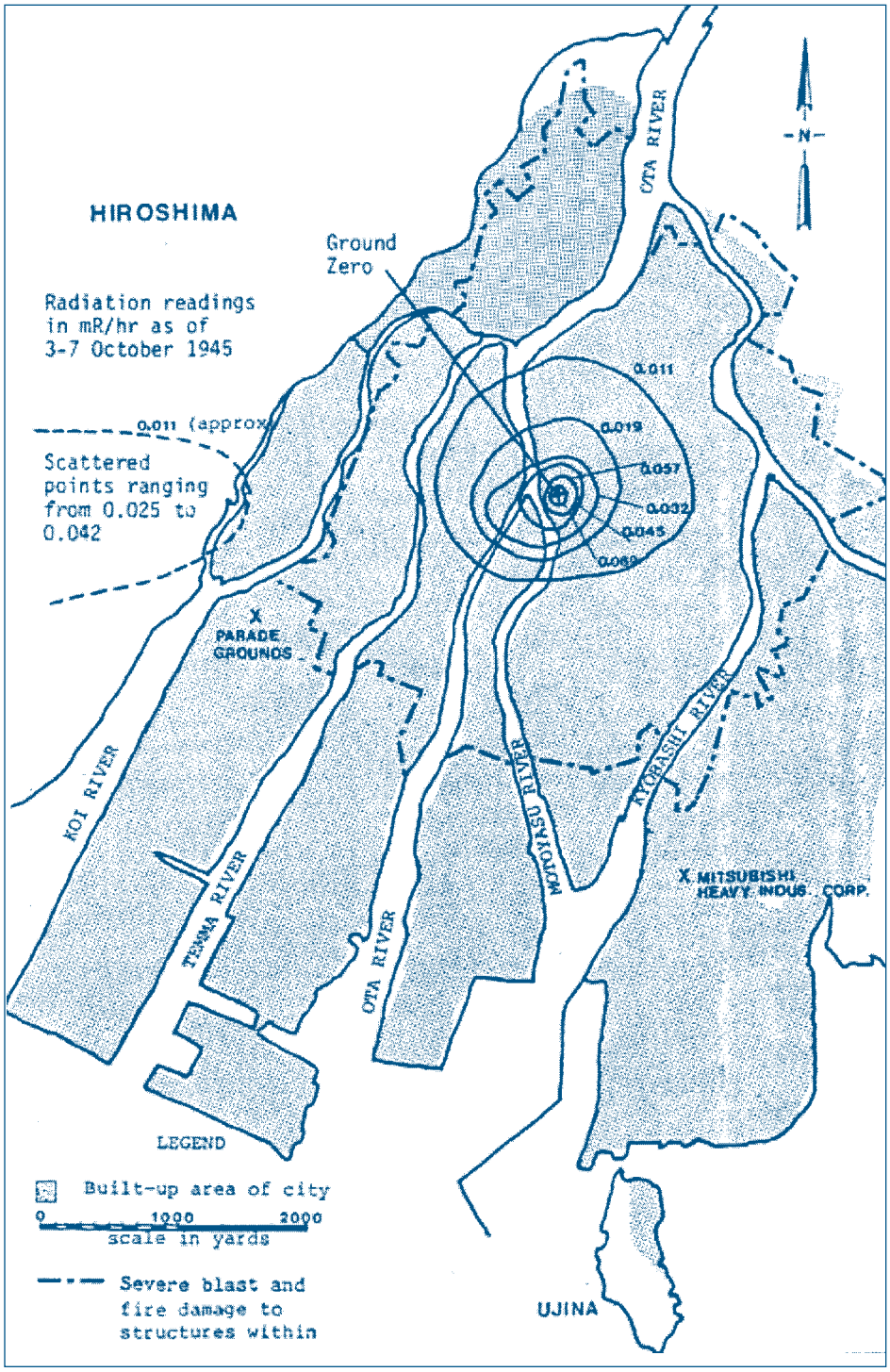

Figure 1. Hiroshima Damage and Radiation Areas

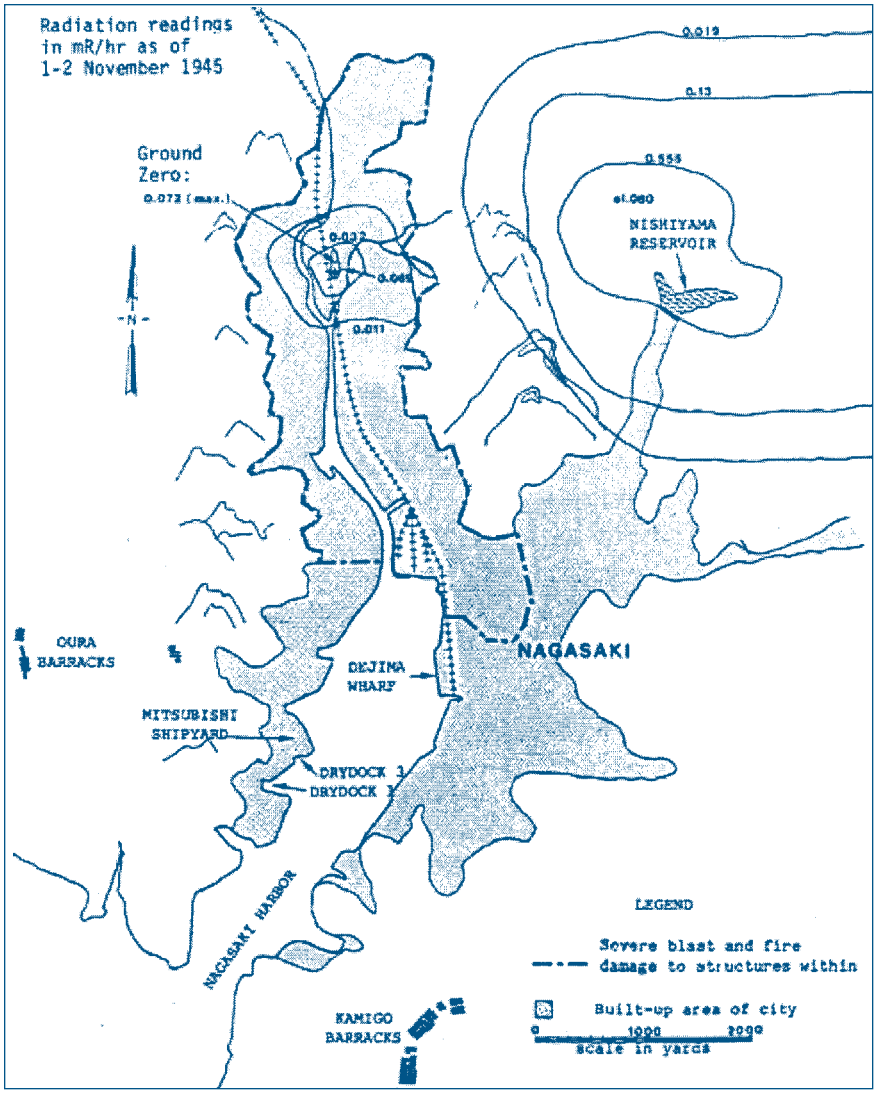

Figure 2. Nagasaki Damage and Radiation Areas

APPENDIX 7

Advisory Committee on Human Radiation Experiments: Final Report

Washington, DC: U.S. Government Printing Office, 1995

Author

Advisory Committee on Human Radiation Experiments, Ruth R. Faden Ph.D., M.P.H., Chair

Preface

On January 15, 1994, President Clinton created the Advisory Committee on Human Radiation Experiments in response to his concern about the growing number of reports describing possibly unethical conduct of the U.S. government and institutions funded by the government in the use of, or exposure to, ionizing radiation in humans at the height of the Cold War. The Committee was charged to uncover the history of human radiation experiments conducted during the period 1944-1974 and the intentional environmental releases of radiation; to identify the ethical and scientific standards for evaluating these events; and to make recommendations to ensure that whatever wrongdoing may have occurred in the past cannot be repeated. This summary provides the key points enumerated that are specifically related to veterans, including Recommendation 6 which is reprinted below in its entirety.

Confidential Record Keeping to Evaluate Potential Liability Claims

Concern for long-term liability stimulated by Crossroads led to steps to guard against the legal and public relations implications if service personnel, who were exposed to radiation, filed disability claims. In 1946, General Paul Hawley, administrator of the Veterans Administration (VA), "became deeply concerned about the problems that atomic energy might create for the Veterans Administration due to the fact that the Armed Services were so actively engaged in matters of atomic energy." In 1947, Hawley met with representatives of the surgeon general's offices of the military services and the Public Health Service. An advisory committee was created and given the name "Central Advisory Committee," as 'it was not desired to publicize the fact that the Veterans Administration might have any problems in connection with atomic medicine, especially the fact that there might be problems in connection with alleged service-connected disability claims."

The committee recommended the creation of an Atomic Medicine Division (AMD) of the VA to handle "atomic medicine matters" and a radioisotope section to "implement a Radioisotope Program." The committee further recommended that "for the time being, the existence of the Atomic Medicine Division be classified as 'confidential' and that publicity be given instead to the existence of a Radioisotope Program." This history is contained in a 1952 report presented by Dr. George Lyon to the National Research Council.

Working with the VA and the Defense Department, the Advisory Committee on Human Radiation Experiments sought to retrieve what information could be located regarding the AMD and any secret record keeping in anticipation of potential veterans' claims from radiation exposures. Among the documents found was a Confidential, August 1952, letter to the attention of Dr. Lyon in which the Defense Department called for comment on the Army's proposal to "eliminate the requirement for maintaining detailed statistical records of radiological exposures received by the Army personnel." The requirement, the letter recorded, "was originally conceived as being necessary to protect the government's interest in case any large number of veterans should attempt to bring suit against the government based on a real or imagined exposure to nuclear radiations during an atomic war."

In 1959, Dr. Lyon was recommended for a VA "Exceptional Service Award." In a memo from the VA chief medical director to the VA administrator, Dr. Lyon's work on both the publicized and confidential programs was the first of many items for which Dr. Lyon was commended. Following a recitation of the 1947 developments similar to those stated by Dr. Lyon in his 1952 report, the memo explained: "It was felt unwise to publicize unduly the probable adverse effects of exposure to radioactive materials. The use of nuclear energy at this time was so sensitive that unfavorable reaction might have jeopardized future developments in the field…Dr. Lyon] maintained records of [a] classified nature emanating from the AEC and the Armed Forces Special Weapons Project which were essential to proper evaluation of claims of radiation injury brought against VA by former members of the Armed Forces engaged in the Manhattan project."

The Advisory Committee was unable to recover or identify the precise records that were referred to in the documents. An investigation by the VA inspector general concluded that the feared claims from Crossroads did not materialize and that the confidential AMD was not activated. However, the investigation did not shed light on the specific identity of the records that were kept by Dr. Lyon, as cited in the memo mentioned above. While mystery still remains, the documentation that has been retrieved indicates that prior to the atomic testing conducted in the 1950's, the government and its radiation experts had strong concern for the possibility that radiation risk borne by servicemen might bear longer-term consequences.

Recommendation 6

The Advisory Committee recommends to the Human Radiation Interagency Working Group that it, together with Congress, give serious consideration to reviewing and updating epidemiological tables that are relied upon to determine whether relief is appropriate for veterans who participated in atomic testing so that all cancers or other diseases for which there is a reasonable probability of causation by radiation exposure during active military service are clearly and unequivocally covered by the statutes.

Congress has provided for compensation for veterans who participated in atmospheric atomic tests or the American occupation of Hiroshima or Nagasaki, Japan. The provision of compensation depends on evidence that the veteran has sustained disability from a disease that may be related to radiation exposure.

The Veterans Dioxin and Radiation Exposure Compensation Standards Act of 1984 required the Veterans Administration to write a rule governing entitlement to compensation for radiation-related disabilities. The resulting regulation contains criteria for adjudicating radiation claims, including consideration of a radiation-dose estimate and a determination as to whether it is at least as likely as not that the claimed disease resulted from radiation exposure. The Radiation-Exposed Veterans Compensation Act of 1988 provides that a veteran who was present at a designated event and subsequently develops a designated radiogenic disease may be entitled to benefits without having to prove causation.

The committee recommends that the radioepidemiological tables prepared by the National Institutes of Health in 1985, which identify diseases that may be causally connected to radiation exposures, be updated. The Committee understands that the Department of Veterans Affairs agrees with this recommendation.

APPENDIX 8

From For the Record – A History of the Nuclear Test Personnel Review Program, 1978-1993, by F. Gladeck and A. Johnson, Defense Nuclear Agency, DNA 6041F, March 1996.

6.2 OPERATION CROSSROADS.

Conducted in 1946 at Bikini, CROSSROADS involved approximately 250 ships and 160 aircraft. Verified DoD participants number about 47,400 (JAYCOR, 6 October 1993). The series consisted of an airdrop detonated at a height of 520 feet and an underwater shot conducted at a depth of 90 feet, as shown in **Table 6-3**.

Table 6-3. CROSSROADS Shots.

Shot	Date (1946)	Type	Yield (kilotons)
ABLE	1 July	Airdrop	21
BAKER	25 July	Underwater	21

The nuclear devices were similar to the TRINITY device and to the weapon detonated over Nagasaki, Japan (Berkhouse and others, 1 May 1984, p.17).

Among the numerous observers of these two detonations was First Lieutenant David J. Bradley, an Army doctor trained as a radiological safety monitor. He made the following observations of ABLE and BAKER from a Navy aircraft approximately 20 nautical miles from each detonation:

ABLE: At twenty miles [it] gave us no sound or flash or shock Then, suddenly we saw it – a huge column of clouds, dense, white, boiling up through the strata-cumulus, looking much like any other thunderhead but climbing as no storm cloud ever could. The evil mushrooming head soon began to blossom out. It climbed rapidly to 30,000 or 40,000 feet, growing a tawny-pink from oxides of nitrogen, and seemed to be reaching out in an expanding umbrella overhead.... For minutes the cloud stood solid and impressive, like some gigantic monument, over Bikini. Then finally the shearing of the winds at different altitudes began to tear it up into a weird zigzag pattern (Bradley, 1948, p.55).

BAKER: This shot in broad day, at fifteen miles, seemed to spring from all parts of the target fleet at once. A gigantic flash – then it was gone. And where it had been now stood a white chimney of water reaching up and up. Then a huge hemispheric mushroom of vapor appeared like a parachute suddenly. By this time the great geyser had climbed to several thousand feet. It stood there as if solidifying for many seconds, its head enshrouded in a tumult of steam. Then slowly the pillar began to fall and break up. At its base a tidal wave of spray and steam arose, to smother the fleet and move on toward the islands. All this took only a few seconds, but the phenomenon was so astounding as to seem to last much longer (Bradley, 1948, p.93).

Figure 6-4 shows the BAKER detonation

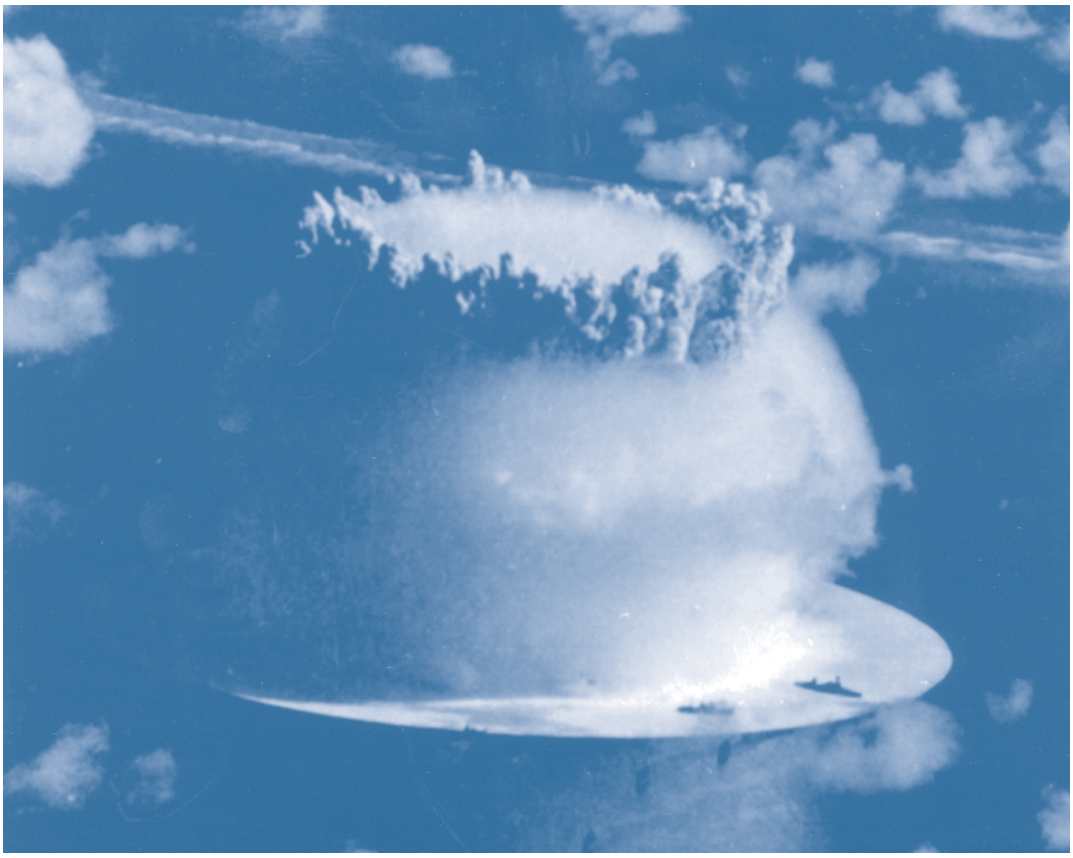

Figure 6-4. Shot BAKER emerging amidst the unmanned target fleet, 25 July 1946.
(Joint Task Force One, 18 BAKER #3, 1946.)

6.2.1 Background and Objectives of CROSSROADS.

After the strategic atomic bomb attacks on Japan had abruptly ended World War II, many military leaders felt that military science was at a crossroads. Vice Admiral W.H.P. Blandy, who directed CROSSROADS declared that perhaps civilization itself, had been brought to a turning point by this revolutionary weapon. With this thought in mind, he named the initial postwar test series (National Geographic Magazine, April 1947, p.529).

As early as August 1945, the Chairman of the Senate's Special Committee on Atomic Energy proposed that the effectiveness of atomic bombs be demonstrated on captured Japanese ships. In September, the General of the Army, H. H. Arnold, Commander of the Army Air Forces, put the question of such a test before the Joint Chiefs of Staff (JCS). The ensuing discussion and recommendations led President Harry Truman to announce, on 10 December 1945, that the U.S. would further explore the capabilities of atomic energy in the form of scientific atomic bomb tests under JCS jurisdiction (Berkhouse and others, 1 May 1984, p.18).

CROSSROADS was designed to produce information not available from the Trinity test or the Hiroshima and Nagasaki bombings. The primary purpose was to determine the effects of atomic bombs on naval vessels. The secondary purposes were to provide training for aircrews in attack techniques using atomic bombs against ships and to determine atomic bomb effects upon other military equipment and installations (Berkhouse and others, 1 May 1984, p.18).

6.2.2 CROSSROADS Test Operations.

A fleet of more than 90 target vessels was assembled in Bikini Lagoon for CROSSROADS. The target fleet consisted of older U.S. ships, such as the aircraft carriers USS SARATOGA (CV 3) and USS INDEPENDENCE (CVL 22), the battleships USS NEVADA(BB 36), USS ARKANSAS (BB 33), USS PENNSYLVANIA (BB 38), and USS NEW YORK (BB 34), surplus U.S. cruisers, destroyers, submarines, and a large number of auxiliary and amphibious vessels. The German cruiser PRINZ EUGEN and two major captured Japanese ships, the battleship NAGATO and the cruiser SAKAWA, also were targets. The support fleet comprised more than 150 ships that provided quarters, experimental stations, and workshops for most of the approximately 43,000 participants, more than 39,000 of whom were Navy personnel (Berkhouse and others, 1 May 1984, pp.1, 84).

In contrast to all other U.S. atmospheric nuclear test series, a large media contingent was present for both CROSSROADS detonations. Quartered aboard USS APPALACHIAN (AGC 1), the correspondents numbed 131 and were from newspapers, magazines, and the radio networks (Anonymous, no date). Included were correspondents from Australia, Canada, France, the Republic of China, the Soviet Union, and the United Kingdom. All Hands, a Navy magazine of the period, reported that:

> The press will be allowed to cover the test atomic bomb explosions at Bikini with sufficient thoroughness to satisfy the public as to the fairness and general results of the experiment, but not so completely that military information of value to the enemy will be disclosed (Bureau of Naval Personnel, 1 July 1946).

ABLE operations went smoothly. The radioactivity created by the airburst had only a transient effect. Within a day, radiation intensities in the lagoon had decayed to less than 0.1 R/24 hours, and nearly all the surviving target ships had been safely reboarded. The ship inspections, instrument recoveries, and remooring necessary for the BAKER test proceeded on schedule (Berkhouse and others, 1 May 1984, pp. 1, 217).

BAKER, on the other hand, presented difficulties. The underwater detonation caused most of the target fleet to be bathed in radioactive water spray and debris. With the exception of 12 target vessels in the lagoon and the landing craft beached on Bikini Island, the surviving target fleet was too radiologically contaminated for many days for more than brief on-board activities. During the first week of August, attempts were made to decontaminate the vessels. By 10 August, upon the advice of Colonel Stafford Warren, the Chief of the Radiological Safety Division, the Task Force Commander decided to terminate these efforts and tow most of the remaining target fleet to Kwajalein Atoll for possible decontamination (Berkhouse and others, 1 May 1984, pp.178-187).

In the latter half of August 1946, the surviving target ships were towed or sailed to Kwajalein Atoll. Eight of the major ships and two submarines were towed back to the U.S. for radiological inspection. Twelve target ships were so lightly contaminated that their crews remanned them and sailed them back to the United States. The remaining target ships were destroyed by sinking off Kwajalein Atoll, near the Hawaiian Islands or off the California coast during 1946 to 1948. The support ships were decontaminated as necessary at various Navy shipyards, primarily in San Francisco and Long Beach, California (Berkhouse and others, 1 May 1984, pp.178-187).

6.2.3 Dose Summary for CROSSROADS.

CROSSROADS operations were undertaken under radiological supervision intended to keep personnel doses below 0.1 R (rem) of gamma radiation per day. About 15 percent of the participants were issued film badges. Personnel anticipated to have the most potential for exposure were badged, and a percentage of each group working in less radioactive areas were badged (Berkhouse and others, 1 May 1984, pp.2-3). Thus, because radiation dose data are not complete, reconstructions have been made of personnel doses for unbadged crewmembers of the ships involved. The calculations rely upon the radiation measurements recorded by radiation safety personnel in 1946 and use the types of methods discussed in Section 8.

In the fall of 1983, the papers of Colonel Stafford Warren, the chief of radiological safety at CROSSROADS, were released. His papers revealed certain data that had not been found in previous archival searches. When introduced into the reconstruction model, the data had the effect of reducing the reconstructed doses of many CROSSROADS personnel. **Table 6-4** summarizes the presently available dosimetry information:

Table 6-4. Summary of external doses for Operation CROSSROADS as of 30 September 1993.

	Gamma dose R (rem)						
	0	**>0-0.5**	**>0.5-1.0**	**>1.0-3.0**	**>3.0-5.0**	**>5.0-10.0**	**>10.0**
Army*	2,290	1,070	147	9	1	0	0
Navy	6,917	23,258	7,448	4,038	11	0	0
Marines	211	378	0	0	0	0	0
Coast Guard **	1	5	1	0	0	0	0
Foreign Military Observers	0	3	0	0	0	0	0
Total for each column	9,319	24,714	7,596	4,047	12	0	0
Cumulative total							**45,689**

* *At the time of CROSSROADS the Air Force was part of the Army.*

** *Coast Guard personnel were present at some oceanic test series.*

APPENDIX 9

From For the Record – A History of the Nuclear Test Personnel Review Program, 1978-1993, by F. Gladeck and A. Johnson, Defense Nuclear Agency, DNA 6041F, March 1996.

6.10 OPERATION CASTLE.

CASTLE was conducted at Enewetak and Bikini Atolls during the spring of 1954. The first event of this series, Shot BRAVO, had a yield of 15 megatons and was the largest device ever detonated by the U.S. Government as part of atmospheric nuclear weapons testing. **Table 6-19** provides specifics on this detonation, shown in **Figure 6-8,** as well as the other five in the series (Martin and Rowland, 1 April 1982, p.1):

Table 6-19. CASTLE shots.

Shot	Date (1954)	Type	Yield
BRAVO	1 March	Surface	15 megatons
ROMEO	27 March	Barge	11 megatons
KOON	7April	Surface	110 kilotons
UNION	26 April	Barge	6.9 megatons
YANKEE	5 May	Barge	13.5 megatons
NECTAR	14 May	Barge	1.69 megatons

6.10.1 Background and Objectives of Operation CASTLE.

CASTLE was the culmination in the development of the hydrogen bomb that began in 1950. Shot GEORGE, a test in the 1951 GREENHOUSE series, had demonstrated the initiation of a sustained thermonuclear reaction by use of a fission reaction. Fusion, or thermonuclear, reactions had been used in 1952 to generate the very powerful detonation of the MIKE device in Operation IVY, but MIKE was not a deliverable nuclear weapon. In BRAVO, the first CASTLE test, a device more powerful than MIKE was exploded that, although not a weapon, was capable of delivery by an aircraft.

CASTLE also was the first Pacific series in which LLNL provided a nuclear device for testing, detonated as Shot KOON. All previous nuclear test devices had been designed at LANL (Martin and Rowland, 1 April 1982, p.26).

6.10.2 CASTLE Test Operations.

Numerous technical experiments were carried out in conjunction with each of the six detonations. These experiments measured the yield and efficiency of the devices and attempted to gauge the military effects of the explosions. The approximately 18,500 verified DoD participants in this series had duty stations at the AEC design laboratories or were members of units performing separate experiments or various support roles (JAYCOR, 6 October 1993). Almost all of the Navy support personnel were at Bikini, where Navy ships provided living quarters for participants who were evacuated from the islands for the first test and then could not return to live there because of the potential for radiation exposure from BRAVO fallout (Martin and Rowland, 1 April 1982, p.2).

6.10.3 Dose Summary for Operation CASTLE.

Among the CASTLE detonations, only BRAVO produced significant, unexpected personnel radiation exposures. This first shot of the series, which significantly exceeded its expected yield, released unprecedented quantities of radioactive materials into the atmosphere. Ambient winds dispersed the radioactive particles over a much larger area than had been anticipated. This resulted in contamination and exposure of Marshall Island residents, Japanese fishermen, and U.S. personnel on distant atolls or aboard various vessels. Acute radiation effects were observed among some of these people.

Some DoD personnel exceeded the maximum permissible limit of 3.9 R (rem) of gamma radiation within any 13-week period of the operation. BRAVO fallout on some Navy ships resulted in personnel who had doses approaching or exceeding this limit. To allow for completion of the CASTLE tests, it became necessary to issue a number of waiver authorizations permitting doses of as much as 7.8 R (rem) to specific individuals. In a limited number of shipboard cases, even this level was exceeded. Substantial overdoses from BRAVO, the highest for any test series, were accrued by the 28 Air Force and Army personnel on Rongerik Atoll. Film badge readings suggest that three members of the U.S. Navy Bikini Boat Pool also may have received substantial doses in excess of the series limits; however, a thorough investigation at the time failed to indicate reasons for these readings (Martin and Rowland, 1 April 1982, pp.243-244). As a result of BRAVO, 21 individuals on USS PHILIP (DDE 498) and 16 on USS BAIROKO (CVE 115) sustained lesions that were classified as beta burns, all of which healed without complications (Martin and Rowland, 1 April 1982, pp.243-244). **Table 6-20** summarizes available dosimetry data.

Table 6-20. Summary of external doses for Operation CASTLE as of 30 September 1993.

	Gamma dose R (rem)						
	0	**>0-0.5**	**>0.5-1.0**	**>1.0-3.0**	**>3.0-5.0**	**>5.0-10.0**	**>10.0**
Army	27	338	795	344	65	13	2
Navy	417	4,359	1,457	2,385	686	336	12
Marines	3	169	8	99	29	5	0
Air Force	286	807	201	967	63	32	32
Field Command	4	3	3	8	0	0	0
Total for Each Column	737	5,676	2,464	3,803	843	386	46
Cumulative total							13,955

Figure 6-8. Shot BRAVO, 1 March 1954.
(Air Force, Lookout Mountain Laboratory Photograph, 22-AQB-1-13, BRAVO, 1954.)

APPENDIX 10a

Mortality and Cancer Frequency among Military Nuclear Test (Smoky) Participants, 1957 through 1979

Journal of the American Medical Association. 1983 Aug; Volume 250, Number 5, pages 620-624

Authors

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Introduction

In this follow-up to a previous report, the authors undertook to identify and locate all test participants and to ascertain their health status and causes of death during the 22 years following the nuclear test "Smoky," detonated on August 31, 1957. This report adds information on incidence of neoplastic diseases and on mortality from all causes.

Subjects and Methods

Several sources provided identifying, locating, and health status data about the Smoky test participants since no single source contained all the needed information. The number investigated was 3,072 of the 3,217 test participants on military maneuvers during the 1957 nuclear test. If a participant reported a malignant neoplasm, the authors attempted to confirm the presence and type of neoplasm. They accepted the cause of death for conditions other than malignant neoplasm as recorded on the death certificate. Person-years at risk were used for calculating the expected incidence and mortality. Expected incidence was calculated by applying age- and sex-specific rates for the person-years accumulated by the Smoky cohort from 1957 through the end of 1979. The gamma radiation exposure data were cumulative, as reported on all film badges for 1957. No primary data were available for other radiation types and the data for beta radiation exposures were limited to Smoky film badges.

Results

Incidence of Neoplasms: The number of newly diagnosed cancer cases (112) did not exceed the number expected (117.5) for the 22-year follow-up. However, the leukemias showed a statistically significantly increased incidence. All cancers not listed and cancers of unknown site were also statistically significantly increased. Cancers of the digestive, respiratory, genital, and urinary systems occurred less often than expected. No cases of cancer of either bones and joints, soft tissues, endocrine system, or multiple myeloma were found. When cancer frequency was analyzed by unit, some had slightly more cancer cases than expected, but none of these increases was statistically significant. The largest increases occurred in the smaller units.

The authors previously reported information about the dates of birth, diagnosis, and cumulative gamma radiation exposure in 1957 for the leukemia cases. Since that report, they have identified and confirmed by medical records review an additional case of chronic myelocytic leukemia diagnosed in 1978. This case occurred in a participant who had been treated with radiation for a lymphoma that was diagnosed in 1976. Pertinent data showed that he was 28 years old, received 140 mrem of cumulative gamma radiation during 1957; the latent period was 19 years. The authors were unable to document the total amount of radiation given for treatment of his lymphoma.

Mortality: This cohort had considerably fewer total deaths than expected from the mortality rates for all United States males. Increases in the number of deaths occurred in only three categories – infectious and parasitic diseases, accidents, and killed in action. Only in the latter category was the increase statistically significant. Deaths from individual types of cancer showed excesses in five groups – skin melanoma, genital system, eye and orbit, brain and nervous system, and leukemia. Only the number of deaths from leukemia is statistically significant compared with the expected number of deaths calculated from US male death rates.

Radiation Exposure: The cumulative 1957 gamma radiation exposure for various groups of participants showed generally low exposures, well within the occupational safety limit of 5,000 mrem/yr. Only 14 persons received exposure between 5,000 and 10,500 mrem. When the mean cumulative gamma radiation exposure was reviewed, the field units had, in general, somewhat higher cumulative gamma radiation exposure readings. The other support units had lower cumulative gamma radiation exposure but a higher frequency of cancer; this result is an apparent contradiction if radiation was the causal factor.

Comment

These data showed a statistically significant increase only for leukemia incidence and mortality. These findings are consistent with those previously reported when 76% of the participants had been contacted. The additional leukemia case did not change the results previously reported in any major way. Although the reasons for undertaking this study in early 1977 were the report of this leukemia case in one participant and his fear that other unreported cases had occurred, the authors expected that some kind of accident was most likely. They did not expect to find only the small exposures recorded on the film badges.

This follow-up added little to resolve the exposure-level controversy because of the uncertainty surrounding the claims and counterclaims of the reported exposure data. In any case, the exposures reported were low. Previous studies that reviewed exposure data reported only small differences from theoretical calculated exposures, but they may not entirely account for the possibility of exposures not recorded on the film badges. However, these data could not resolve this question because of the small number of persons involved, the potential bias of case and group selection, and the possible loss of other cases in the unlocated participants. Further support for the idea that the overall radiation exposures were low is the result from the review of the cancer occurrence and radiation exposure of the individual units. Although some units had an increased cancer frequency, most were not the field units that generally had higher mean cumulative gamma exposures, because the latter spent more time in the fallout fields on the day of detonation. Finally, most of the statistically insignificant cancer increases occurred in 15 of 36 units with mean cumulative gamma exposures less than the overall mean (456 mrem).

This study showed only an increase in frequency of occurrence of leukemia and death from leukemia that confirms the index case's impression about the Smoky participants. However, the low overall cancer incidence and mortality, the low level of exposure (uncertain as it was), and the lack of correlation between field unit and mean cumulative radiation exposure suggested that this one positive finding may be either attributable to chance or the result of an unknown combination of factors. Furthermore, this conclusion cannot be generalized to include participants at other nuclear tests or resolve the low-dose controversy.

APPENDIX 10b

Cancer Mortality Risk Among Military Participants of a 1958 Atmospheric Nuclear Weapons Test

American Journal of Public Health. 1995 Apr; Volume 85, Number 4, pages 523-527

Authors

Kevin K. Watanabe, M.S., Han K. Kang, Dr. P.H., and Nancy A. Dalager, M.S.

Introduction

In view of the findings of earlier studies and the continuing concerns for the health of veterans who participated in nuclear weapons tests, this study of the military participants of the Hardtack I test series was undertaken to determine whether they were at higher risk for dying from certain cancers. This test series was not included in previous studies and was selected because it had one of the highest proportions of participants with film dosimetry data.

Identification of Study Subjects

Of the 13,910 verified participants of the Hardtack I test series, 13,713 served in the military. A total of 2,382 of the veterans who served in multiple test series were excluded from the study cohort because of the difficulty in determining the contributory effect of their participation in other nuclear tests. Of the remaining 11,331 veterans, 2,777 served in branches other than the Navy and were excluded. The resulting 8,554 Navy veterans were included in this study cohort; they had a median gamma level of 388 mrem. A total of 14,625 veterans were included in the non-participant Navy group. Radiation dosage information was determined by individual film badges for 88% of the veterans. Estimated doses were calculated for the remaining individuals by using the film badge levels of those who served in the same military unit or occupation.

Vital Status Determination for Mortality Analysis

Each of the veterans was followed for vital status from September 1, 1958, the month after the last Hardtack I test, until his death or September 1, 1991, whichever occurred first. Vital status was determined by matching the subjects' names and military service numbers against those in the VA Beneficiary Identification and Record Locator Subsystem (BIRLS). The underlying cause of death for each subject was coded.

Statistical Methods

The analysis of the mortality data was approached in three stages. In stage 1, a simple comparison of the relative frequency of overall deaths as well as of specific causes of death was made between the Hardtack participants and the non-participant Navy veterans based on person-years at risk. In stage 2, the Cox proportional hazards model was used to estimate mortality risk among overall Hardtack participants as well as among a specific exposure group relative to the mortality of risk among the non-participant veterans. In stage 3, cause-specific number of deaths in both groups of veterans were compared with the number of expected deaths.

Results

There was a significant excess of deaths among the Hardtack participants from all causes. Mortality from cancer of the digestive organs was also significantly elevated among the Hardtack participants compared with the non-participant veterans. However, mortality rates from all cancers combined and from many other a priori cancers of interest were not statistically elevated. Further analysis of leukemia, excluding chronic lymphocytic leukemia, was conducted and no significant difference was found. None of the Hardtack participants, and only two non-participant veterans, died from chronic lymphocytic leukemia.

The Hardtack participants in each radiation gamma dose category were compared with the non-participant veterans using the proportional hazards model. Statistically significant relative risks were observed for all causes, all cancers, and liver cancer in the high-dose (>1000 mrem) group, for pancreatic cancer in the medium-dose (251 to 1000 mrem) group, and for cancer of the digestive organs in the low-dose (0 to 250 mrem) group. The number of deaths due to liver cancer was small. When both groups were compared with the general US population, the only risk that was significantly elevated was for prostate cancer among the Hardtack participants.

Discussion

Unadjusted rate ratios from all causes of death and from cancer of the digestive organs were significantly elevated for Hardtack participants compared with the non-participant veterans. Cancer of the prostate was significantly elevated among the Hardtack participants compared with US men and higher among the participants compared with the non-participants, but it was not significantly significant.

Estimates of the external radiation doses for the participants were reported to be so low (<0.5 rem for most veterans) that no detectable increase in cancer risk would have been expected on the basis of cancer risk estimates derived from high-dose studies. There were an estimated 32 excess cancer deaths in this study; therefore, the cancer risk observed in the Hardtack participants is about five to six times larger than the projected magnitude of risk.

There are several possible explanations for this result. First, the observed excess risk among Hardtack participants may have been a spurious association due to statistical aberrations including multiple comparisons. Second, the risk estimates become very uncertain when applied to very low does. Third, the Defense Nuclear Agency's estimates of radiation exposure levels for the Hardtack participants might have been much lower than the actual exposure levels. The accuracy of those estimates has been questioned, especially when the dose levels were reconstructed without measurements from film badges.

Among the several limitations of the study: the reliance on death certificates rather than on medical records for information on cause of death; no information was available on potential confounders, such as smoking and drinking habits of the veterans and their post service exposure to known occupation carcinogens; and the study veterans as a group were still relatively young and more than 87% of them were still alive at the end of the follow-up period. The major advantage of this study was the inclusion of a Navy veteran comparison group.

In summary, although reported radiation doses for the Hardtack participants were generally under 500 mrem, the possibility that the veterans who participated in the atmospheric nuclear test may be at an increased risk of death from certain cancers cannot be ruled out at this time. This group of veterans should continue to be monitored for their mortality outcomes.

APPENDIX 10c

Mortality of Veteran Participants in the CROSSROADS Nuclear Test

Washington, DC: National Academy Press, 1996

Author

Christopher Johnson, Susan Thaul, William F. Page, Harriet Crawford with oversight from the National Academy of Sciences' Institute of Medicine Committee on the CROSSROADS Nuclear Test

Preface

In response to Public Law 98-160 that directed the Department of Veterans Affairs (VA) to provide for the conduct of epidemiological studies of the long-term adverse health effects of exposure to ionizing radiation from detonation of nuclear devices, a proposal was made to compare the mortality experience of veteran participants in the CROSSROADS nuclear test to a similar group of non-participants. Operation CROSSROADS involved approximately 40,000 military personnel, mostly Navy, and occurred in July of 1946 at the Bikini Atoll in the Marshall Islands.

Summary

A roster of CROSSROADS participants was assembled and provided to the Medical Follow-up Agency (MFUA) by the Nuclear Test Personnel Review (NTPR) program of the Defense Nuclear Agency. A validation study found that the final roster captured between 93 and 99 percent of the military personnel who participated in Operation CROSSROADS. The mortality data gathered from VA records were validated by sample comparisons with other national data sources. By the study cut-off date, 31 December 1992, 31.3 percent
of the participants and 30.8 percent of the comparison cohort were known to have died. Cause of death was available for 86.3 percent of the participants and 89.3 percent of the controls. The study looked at three principal causes of mortality (all-cause, all-cancer, and leukemia) and hypothesized that increases in the latter two could result from radiation exposure. For descriptive purposes, comparisons between participants and the comparison group for 44 other disease categories were also presented. Findings stated in this report follow:

Among Navy personnel, the primary analysis group for the study, participants at the CROSSROADS nuclear test experienced higher mortality than a comparable group of nonparticipating military controls. The increase in all-cause mortality was 4.6 percent and was statistically significant. For malignancies, the elevation of mortality was lower and was not statistically significant. Similarly, leukemia mortality relative risk was elevated, but not significantly and by less than all-cause mortality. The increase in all-cause mortality did not appear to concentrate in any of the disease groups considered. Of the 44 other specific cancers and disease categories examined, there were no statistically significant increases in mortality. The overall elevation of mortality rate ratios for malignancies and leukemias in the participants were not statistically significant and, in fact, were lower than for many other causes of death.

Navy mortality due to all malignancies and leukemia did not vary substantially among the exposure surrogate groups (i.e. those who boarded target ships after a detonation vs. those who did not, and those enlisted personnel who had an Engineering & Hull (E&H) occupational specialty vs. those in other specialties).

Participants who boarded target ships were thought to be more highly exposed than the rest of the participant group. Relative to the controls, boarding participants experienced a 5.7 percent increase in all-cause mortality, whereas the non-boarders experienced a 4.3 percent increase. Aside from all-cause mortality, risks for boarding participants did not significantly exceed those for controls for any of the disease categories, and risk relative to controls were similar for boarding and non-boarding participants. The increase in risk for all-malignancies among the participants was 2.6 percent for boarders and 1 percent for non-boarders. For leukemia, the increase in mortality risk for boarders was 0.7 percent and for non-boarders, 2.4 percent. The difference between boarders and non-boarders could be due to chance.

Those Navy participants holding an E&H occupational specialty were thought to be more highly exposed to radiation than their non-E&H counterparts. However, the E&H participants had essentially the same risk of mortality from all causes as non-E&H participants. For all malignancies and leukemia, the rate ratios were somewhat higher, but both could be attributed to chance. Risk ratios for leukemia and malignancies among E&H controls showed a similar elevation relative to non-E&H controls, suggesting that a factor specifically associated with CROSSROADS was not likely to have been the cause.

Conclusions

These findings do not support a hypothesis that exposure to ionizing radiation was the cause of increased mortality among CROSSROADS participants. Had radiation been a significant contributor to increased risk of mortality, then significantly increased mortality due to malignancies (particularly leukemia) should have been seen in participants thought to have received higher radiation doses relative to participants with lower doses, and to unexposed controls. No such effects were observed. This study, however, was neither intended nor designed to be an investigation of low-level radiation effects, per se, and should not be interpreted as such.

In comparing the findings and methods employed in this study with those of other investigations of atomic veteran mortality, a possible self-selection bias in the participant cohort was identified: participants who died of a disease (particularly cancer) may have been more likely than healthy participants to have been identified to the NTPR, and hence become a part of the study. Such a bias could have resulted in an apparent increase in death rates among the participants. Data were not available with which to make a good quantitative estimate of this potential bias. However, mortality from all malignancies and leukemia was lower, not higher, than the increase in all-cause mortality. These factors suggest that a self-selection bias was not entirely responsible for the finding of increased all-cause mortality in study participants.

The authors believe that the elevated risk of all-cause mortality in CROSSROADS participants relative to a comparable military comparison group is probably the result of two factors. The first is an unidentified factor, other than radiation, associated with participation in, or presence at, the CROSSROADS test. The second is a self-selection bias within the participant roster. However, the relative contributions of these two explanations cannot be accurately determined within available resources for this project.

APPENDIX 10d

Cancer Mortality Among the Highest Exposed U.S. Atmospheric Nuclear Test Participants

J Occup Environ Med, Volume 42, Number 8, August 2000, pages 798-805

Author

Nancy A. Dalager, M.S., Han K. Kang, Dr. P.H., Clare M. Mahan, Ph.D.

Introduction

An estimated 205,000 military personnel participated in the U.S. atmospheric nuclear weapons testing program conducted from 1945-1962. Nineteen major atmospheric nuclear test series consisting of numerous individual weapons tests were conducted. Participants were exposed to varying doses of low ionizing radiation. The objective of this study was to determine whether veterans, who participated in the U.S. atmospheric nuclear weapons tests and whose external gamma radiation doses met or exceeded the current federal occupational guideline of 5 rem per year, have experienced increased overall as well as site-specific cancer mortality compared to a cohort of military personnel with a history of very low radiation doses.

Methods

The dose estimates provided for this study by the Defense Nuclear Agency (DNA) database of all veterans who participated in the U.S. atmospheric nuclear weapons testing program represent only external gamma radiation doses. For each test participant, external gamma radiation dose estimates were summed over all the separate detonations within a particular nuclear test series to obtain a series-specific dose. All nuclear test participants serving in the military who had a series-specific gamma radiation dose equal to or greater than 5 rem were selected to be study subjects (1,010 veterans). A group of 2,870 low dose Navy HARDTACK I veterans (identified in this study as Navy controls) were utilized as a comparison cohort.

The 5 rem and over study participants were followed for vital status from the initial date of the test series in which they received their 5 rem or over external gamma radiation dose until December 31, 1996; the start of follow-up varied for these veterans. An indication of death was ascertained from three sources and underlying cause of death and contributing causes were coded.

For multivariate adjustments, the Cox proportional hazards model was used to calculate relative risk estimates of the cause-specific mortality of the 5-rem cohort compared to the mortality of the control cohort. Separate analyses were conducted that utilized the life table method of survival analysis to evaluate the probability of death from all causes and from selected site-specific cancers in eight 5 year intervals of time since radiation dose.

Results

Fifteen of the 19 major U.S. atmospheric nuclear test series conducted from 1945 through 1962 were represented by the group of veterans selected for this study. The total number participating in a specific test series varied widely as did the specific details surrounding each individual test series. The number of series-specific veterans with a 5 rem or more dose in these analyses ranged from 1 to 396.

A subset of 374 veterans who served in the Navy were identified within the cohort of all 5 rem or over participants. A Navy only 5 rem cohort provided for an additional comparison to the Navy controls that is unbiased with respect to branch of service. Except for differences in their radiation doses, these two Navy cohorts should be very similar. The mean radiation dose levels of the total 5 rem and Navy only 5 rem cohorts were approximately 100 times that of the Navy control cohort. The mean radiation doses for the total 5 rem and Navy only 5 rem cohorts were very similar; however, the highest radiation doses were experienced by veterans who served in a branch of service other than the Navy.

The adjusted relative risk estimates from the Cox regression modeling for all veterans with a 5 rem or more radiation dose compared to the Navy controls showed that statistically significant elevated relative risks were observed for all causes of death and for the category of all lymphopoetic cancer. The adjusted relative risk estimates for the Navy only 5 rem cohort compared to the Navy controls showed that statistically significant elevations in the adjusted relative risk estimates were observed for mortality from all causes of death, all lymphopoetic cancers, and the sub-category of miscellaneous lymphopoetic cancers.

Results from the survival analysis for the 5 rem cohort compared to the Navy controls and the Navy only 5 rem cohort compared to the Navy controls were very similar in magnitude and statistical significance to the relative estimates derived from the multivariate Cox proportional hazards model. After forty years of follow-up, the Navy controls experienced a higher probability of survival than the entire 5-rem cohort. The difference in the two survival curves was statistically significant at the .05 level.

Discussion

The number of veterans included in this study with radiation doses of 5 rem or higher was significantly larger than in any previous study. The availability of a control group of Navy test participants with radiation doses that on the average were only 1/100 of the mean dose experienced by the 5 rem cohort and a Navy only subset of the 5 rem group were added strengths of this current study.

Compared to the Navy controls, the U.S. atmospheric nuclear test participants who met or exceeded the federal guidelines of an external gamma radiation dose of 5 rem had significantly elevated adjusted relative risk estimates for mortality from all causes of death, all lymphopoetic cancers, and the subcategory of miscellaneous lymphopoetic cancers. Mortality from leukemia was somewhat elevated, but not statistically significant. When the analysis was restricted to Navy only 5 rem participants compared to the Navy controls, the patterns of excess mortality were similar although somewhat greater than those observed for the entire group of 5 rem participants.

In summary, the U.S. atmospheric nuclear test participants examined here included a group of veterans who received the highest external gamma radiation doses of those recorded for U.S. military personnel. Their radiation doses met or exceeded the current federal occupational guideline of 5 rem per year. While the mortality from all causes and from all lymphopoetic cancers combined among the 5 rem and over veterans was significantly elevated over that of the comparison veterans, the lack of a statistically significant excess in the deaths from many of the known radiogenic cancers, suggests that the excesses in mortality observed in these analyses may be the result of many factors of which radiation was only one.

APPENDIX 10e

The Five Series Study: Mortality of Military Participants in U.S. Nuclear Weapons Tests

Washington, DC: National Academy Press, 1999

Author

Susan Thaul, William F. Page, Harriet Crawford, Heather O'Maonaigh with oversight from the National Academy of Sciences' Institute of Medicine Committee to Study the Mortality of Military Personnel Preset at Atmospheric Tests of Nuclear Weapons

Introduction

More than 200,000 U.S. military personnel participated in atmospheric nuclear weapons tests between 1945 and the 1963 Limited Nuclear Test Ban Treaty. Questions about these tests persist, such as whether test participation is associated with the timing and causes of death among the participants. This report provides the results of a mortality study of the approximately 70,000 soldiers, sailors, and airmen who participated in at least one of five selected U.S. nuclear weapons test series in the 1950s and nearly 65,000 comparable non-participants, the referents. The study examines whether participants died sooner than non-participants or were more likely to die from specific causes such as leukemia. The investigation, based on more than 5 million person-years of mortality follow-up, represents one of the largest cohort studies of military veterans ever conducted.

Methods

This study addresses one primary question: Did participation in at least one of the five selected nuclear weapons test series change the risk of death for the military personnel involved. The study, however, does not address questions concerning the relationships between test participation or radiation exposure and nonfatal adverse health effects. The participant cohort (predominantly white and male) was identified from the database maintained by the Nuclear Test Personnel Review Program (NTPR) at the Defense Threat Reduction Agency. Substantial effort was placed into validating the participation list. The participant cohort's mortality experience was compared with that of a referent cohort of military personnel comparable to the participants. Department of Veterans Affairs (VA) records and databases provided fact of death for members of both cohorts.

Using two analytic techniques, the proportional hazards model and standardized mortality ratios, differences between the participant and referent cohorts were tested in all-cause, all-cancer, and leukemia mortality. Analyses based on the proportional hazards model involved direct comparisons of the participant and referent cohorts, whereas standardized mortality ratios involved comparison of each group, separately, with external population rates. Further explorations included other outcomes and possible differences in effect for participants of test series conducted at the Pacific Proving Ground (sea series) and participants at the Nevada Test Site (land series).

Findings

The study found that during the follow-up period: (1) overall, participants and referents had similar risks of death; (2) participants and referents had similar risks of death from cancer; and (3) specifically, participants had an apparent 14 percent higher risk of leukemia death than the referents, although that difference was not statistically significant and could be a chance finding. Overall, no statistically significant differences in all-cause, all-cancer, or leukemia mortality between participants and referents are evident, although the participant risk of leukemia is 14 percent higher than the referent risk.

The leukemia findings do not resolve the debate over whether either participation in general, or the radiation doses in particular, are associated with leukemia morality. The set of leukemia findings is broadly consistent with a hypothesis that these are radiation effects, but is not conclusive. Only a study cohort four times the size of the one available would have been likely to identify the observed leukemia risk as statistically significant. The sample size available did not provide sufficient power to achieve statistical significance for risks of the magnitudes observed.

Across broad categories of non-cancer deaths, participants and referents had the same mortality risk, except for death due to external causes, for which participates had a significantly higher risk. Neither information about the nuclear tests or current understanding of radiobiology helps to explain this observed higher risk. Statistically significant increases in mortality from nasal cancer and prostate cancer were also found.

Mortality ascertainment in this study was hampered by a lack of a nationwide records system that covered the entire study follow-up period. Stated generally, the mortality ascertainment was slightly more complete for participants than for referents. This could have contributed to the study findings of increased mortality risk among participants. However, all-cause mortality was actually lower among participants than referents.

Discussion

The size, length of follow-up, and persistence of data collection efforts involved in this study assure that the reported findings are valid. It is unlikely that another cohort study of this type and magnitude would provide more precise answers than this one, because any atomic veteran study of this kind would confront the same methodological problems, namely inadequate exposure (dose) data and imperfect mortality ascertainment, encountered in this Five Series study.

Stronger supporting evidence could be acquired from a further study that would make use of data on radiation dose if those data could be developed. Although the oversight committee concluded that the dose data in their current form were unsuitable for epidemiological analysis, it also concluded that carefully carried out custom dose reconstructions done anew for selected participants, using consistent methodology, could provide usable dose data. An efficient research design (to minimize the prohibitive cost of custom dose reconstructions) requiring fewer individuals could focus on specific endpoints of interest, such as leukemia. The pattern of radiation dose among the leukemia deaths (cases) would be contrasted to the pattern among a sampled set of participant controls to assess a hypothesized dose-response association.

One of the primary conclusions of the study is that the participant group as a whole did not experience widespread early death. Even for leukemia, for example, there was an estimated 25 excess deaths in the participant cohort. The report findings do not rule out, however, possible risk among distinct subgroups of test participants.

APPENDIX 11

SPECIFIC DIAGNOSES REPORTED* BASED ON APPROXIMATELY 21000 IONIZING RADIATION REGISTRY EXAMINATION CODE SHEETS

Skin cancer	1185
Posterior subcapsular cataracts	383
Lung cancer	292
Colon cancer	242
Urinary bladder cancer	175
Nonmalignant thyroid nodular disease	106
Leukemia, other	78
Kidney cancer	75
Thyroid cancer	51
Multiple myeloma	38
Bone cancer	32
Esophageal cancer	31
Stomach cancer	29
Primary liver cancer	26
Salivary gland cancer	21
Pancreatic cancer	14
Cancer of the prostate	10
Breast cancer	7
Myeloid leukemia	2
Ovarian cancer	1
Brain and CNS tumors	1
Non-Hodgkin's lymphoma	1

[In addition to the veterans' diagnoses, there were 1091 IRR code sheets reporting birth defects in children and/or grandchildren]

*NOTE: This listing would not include diagnoses made on veterans subsequently to their IRR examinations unless a revised IRR code sheet form was submitted. This listing also does not include diagnoses for which there was no reporting field on the IRR code sheet at the time the examinations were performed, diagnoses coded as "other malignancies not listed" or as "other possible radiogenic diseases".

APPENDIX 12

Adverse Reproductive Outcomes in Families of Atomic Veterans: The Feasibility of Epidemiologic Studies

Washington, DC: National Academy Press, 1995

Author

National Academy of Sciences' Institute of Medicine. Committee to Study the Feasibility of, and Need for, Epidemiologic Studies of Adverse Reproductive Outcomes in the Families of Atomic Veterans

Preface

At the request of the Department of Veterans Affairs and as mandated in Public Law 103-446, Section 508, enacted on November 2, 1994, the Medical Follow-up Agency (MFUA) of the Institute of Medicine (IOM) established a committee to (1) review the available data and scientific literature on the health effects of exposure to ionizing radiation and (2) prepare a report on the feasibility of studying veterans exposed to ionizing radiation and the risk of health effects in their spouses, children, and grandchildren. This report is the result of the committee's work; the document presents the committee's assessment of the feasibility of studies of adverse reproductive outcomes in families of servicemen exposed to ionizing radiation.

Summary

The feasibility of a study hinges largely on the answers to four questions: (1) How is a suitable sample or cohort of exposed persons affected among the total at risk to be defined, and can this be done without inadvertently introducing selection biases? (2) Will that sample or cohort be large enough to reveal effects of the magnitude anticipated on the basis of present knowledge? (3) What is the probable dose distribution among the members of that sample or cohort, and how reliable are the individual dose estimates? (4) What approaches are available for identifying adverse reproductive outcomes accurately and completely? Each of these questions is considered separately in the report.

To evaluate the feasibility of conducting an epidemiologic study, the committee thought the report should begin with a review of the fundamental principles of epidemiology, radiation biology, and genetics. This review is then followed by discussions of current information on the risk of genetic mutations due to environmental exposure, definitions and possible causes of adverse reproductive outcomes, the factors to be considered when determining the feasibility of a study, and finally, a review of possible alternative approaches for evaluating the health effects of exposure to low levels of ionizing radiation.

The task of the committee, as elaborated by the VA, was to address three questions. The questions and the committee's conclusions follow. The background information and rationale that served as a basis for these findings are described in detail in the full report.

1. **Is it possible to conduct an epidemiologic study to determine whether there is an increased risk of adverse reproductive outcomes in the spouses and of adverse health effects in the children and grandchildren of Atomic Veterans?**

Conclusion: The committee's assessment was that there are insurmountable difficulties in finding and contacting a sufficiently large number of study subjects (offspring of Atomic Veterans), in establishing an accurate measure of dose for each veteran, in detecting the extremely small potential risk at low doses, in identifying and reliably documenting reproductive outcomes over a fifty year interval, and in the measuring of other factors that have been observed to cause reproductive problems, and therefore, might confound any observed relationship between radiation exposure and reproductive problems. These difficulties become even greater in the grandchildren of these veterans. The committee concluded, therefore, that the cohort of Atomic Veterans did not provide a practical opportunity for a scientifically adequate and epidemiologically valid study.

2. **If such a study is feasible, approximately how much time and money would be required to organize and implement it?**

Conclusion: Since the committee concluded that an epidemiologic study was not possible, it did not consider in detail the time and money that would be required. However, on the basis of past and current studies of radiation-exposed cohorts, the committee estimated that such a study would cost tens of millions of dollars and would last at least a decade.

3. **Are there other sources of information that would yield similar results at a lower cost or in less time?**

Conclusion: The committee suggested some studies that might be informative, but noted that these too would have limitations. These limitations are related to sample size, population composition, uncertainty of dose, the presence of concurrent disease, and other confounding factors. Although studies of these groups may have their own merits, the committee concluded that they may not adequately address the immediate concerns of the Atomic Veterans.

Report Conclusions

The committee explored in detail the feasibility of an epidemiologic study to examine the association between adverse reproductive outcomes and paternal exposure to ionizing radiation. Such a study would be of interest not only to the 210,000 veterans exposed to atomic weapons radiation, but also to many other individuals who have received low doses of radiation at their places of employment or elsewhere. The committee's assessment was that it would be extremely difficult, if not impossible, to find and contact a sufficiently high and representative percentage of veterans' families, to establish a good measure of dose for each veteran, to identify and accurately document reproductive problems that occurred over a fifty-year interval, and to measure other factors that cause reproductive problems and, therefore, might confound any observed relationship between radiation exposure and reproductive problems. These difficulties become even more acute with regard to the grandchildren of these veterans. The cohort of Atomic Veterans does not provide a practical opportunity for a scientifically adequate and epidemiologically valid test of the hypothesis that paternal exposure to ionizing radiation has increased the frequency of adverse reproductive outcomes among their children and grandchildren. The committee recognized the real concerns of the Atomic Veterans as expressed by their representatives, but concluded that epidemiologic studies cannot adequately address these concerns.

APPENDIX 13

A Mortality Follow-Up Study of WW II Submariners Who Received Nasopharyngeal Radium Irradiation Treatment

American Journal of Industrial Medicine, 2000, Volume 38, pages 441-446

Author

Han K. Kang, Dr. P.H., Tim A. Bullman, M.S., Clare M. Mahan, Ph.D.

Introduction

During World War II, submarine trainees received nasopharyngeal (NP) irradiation therapy to prevent aerotitis media, also know as middle ear barotrauma. The total number of military personnel who received therapy is unknown, although one estimate places the number between 8,000 and 20,000. To date, no follow-up studies have been conducted of military personnel who received NP treatment. This current study, a retrospective mortality follow-up, was undertaken to determine if there is any increased risk of cause-specific mortality, primarily head and neck cancers, among WWII submariners.

Material and Methods

The Naval Submarine Medical Research Laboratory Aerotis Media Study Log Book provided the names and rank of sailors who developed aerotitis media at the Groton Submarine School in New London, CT. After obtaining military service numbers from other Navy Records, 1,214 names were available for study. An estimated 70% of these men received NP radium treatment but, because of the lack of certain means to separate those who were treated with NP radium from those who were not, this study considered all 1,214 test participants on the logbook with a sign of aerotitis media as radium “treated” veterans.

Comparison group veterans consisted of 3,176 submarine trainees who were randomly sampled from 24,000 sailors who attended basic training at the Groton Submarine Base after WWII. The last recorded use of NP radium treatment at the submarine base was in May, 1946. It was, therefore, very unlikely that the trainees who joined the Navy after 1946 and subsequently trained at the submarine base would have received treatment during training.

Treated veterans' vital status was followed from the date of their pressure test in 1944 or 1945. Control group veterans' vital status follow-up began on the date that they reported to Groton and ended on their date of death or on December 31, 1996. After ascertaining vital status, 434 deaths were identified among treated veterans and 605 deaths among control veterans; cause of death data was obtained for 376 (87%) of deaths among treated veterans and 530 (88%) of deaths among control veterans.

Results

Cause-specific mortality risk associated with NP therapy was assessed using the survival analysis method. The overall mortality risk was significantly higher among treated participants than for controls [odds ratio (OR)=1.32; 95% Confidence Interval (CI)=1.14-1.53] and there was increased risk of deaths due to diseases of the circulatory system [OR=1.51; 95% CI=1.20-1.90].

The increased risk of death due to head and neck cancers remained elevated, but not statistically significant [OR=1.40; 95% CI=0.54-3.58]. The paired cause-specific survival curves were tested for significance between veterans and controls for all causes, diseases of the circulatory system, and head and neck cancer.

Results from the multivariate Cox model were similar to the survival analyses. To keep the entire age range comparable, the length of follow-up for the treated group was reduced by 7 years. Thus, length of follow-up extended forty-four years for both groups – 1945-1989 for the treatment group and 1952 (average)-1996 for controls.

Discussion

Prior studies have reported inconsistent results concerning the increased risk of head and neck cancers among those who received NP treatments. Comparing the survival curve of submarine veterans, at least 70 percent of whom received NP treatments, to that of a group of submarine veterans who did not have a record of receiving treatments, this study found a small increased risk of deaths due to all cancers combined and head and neck cancers associated with having had NP irradiation therapy; neither was statistically significant.

The difference in all circulatory disease mortality rates between two submariner groups was not anticipated. The lower rate of deaths from circulatory disease among controls might be due to a difference in selection process taking place in the assignments to submarine duty during and after WWII or a life style difference between the two birth cohorts.

The lack of data on possible risk factors, other than receiving NP irradiation therapy, is a limitation in interpreting this study's findings. Another limitation is the inclusion of some submariners who did not receive the treatment in the "treated' group. According to the Logbook record, approximately 30 percent of submariners classified as "treated" may not have actually received the treatment. As a result, the chances of detecting any specific mortality outcomes associated with the treatment were reduced if any existed. Differences in the life expectancy of the two cohorts might also have affected this study's findings. All of the treated veterans entered follow-up in 1944/45 and their mortality pattern would reflect the pattern prevalent in the age groups 18-24 (mean 22.5 years) in 1944/45. The pattern prevalent in this age group at a later date could be different because the expected length of life would be greater. A final limitation was the lack of morbidity data; the data provided may not be a surrogate for incidence data for all diseases.

A strength of this study was the use of other submariners as a comparison group. As submariners were a self-selected group of volunteers and underwent various specialized physical and psychological screening, the most appropriate comparison group for submariners who received NP radium treatment would be other submariners who did not receive the treatment. Using a veteran group as a comparison group also helps to limit the "healthy veteran" effect. This phenomenon may affect findings when veteran groups are compared only to the US population.

In summary, comparing cause-specific mortality of submarine veterans who were "treated" with NP irradiation to that of "untreated" submarine veterans, this study found an excess of overall deaths as well as deaths due to all disease of the circulatory system. While the excess risk of head and neck cancers was not statistically significant, this finding does suggest that WWII veterans who received NP irradiation while in submarine school may be at increased risk for deaths due to head and neck cancers.

APPENDIX 14

Summary of Article on Health Effects of Depleted Uranium on Exposed Gulf War Veterens

Environmental Research, Vol. 82, No. 2, Feb 2000, pp. 168-180

Author

Melissa A. McDiarmid, James P. Keogh, Frank J. Hooper, et. al.

Summary

Prepared by Michael Howe

Introduction

In 1993-94, thirty-three depleted uranium (DU) exposed Gulf War veterans, many with retained fragments of embedded DU shrapnel, underwent medical evaluation at the Baltimore Veterans Affairs Medical Center. Clinical evaluation documented severe persisting health problems related to wounds sustained at the time of initial injury. This group of DU-exposed veterans was reexamined in 1997, and clinical laboratory elements, uranium exposure assessment, psychiatric assessment, neurocognitive evaluation, genotoxicity studies, and whole-body radiation counting were evaluated. The results of that assessment are reported in this article.

Materials and Methods

Twenty-nine of the originally evaluated 33 male DU-exposed veterans were reevaluated and their results were compared with those of 38 non-DU-exposed Gulf War deployed veterans. The clinical assessment elements included obtaining a detailed questionnaire history, a thorough physical examination, and laboratory studies, including hematologic and renal functional measures. All participants were administered a neurocognitive test battery. Urinary uranium determinations were performed both on 24-h urine collections and on a random spot collection. Uranium concentrations in semen specimens were measured. Whole-body radiation counting was conducted at the Boston VA Medical Center. Reproductive health measures were examined also.

Results

The results of 24-h urine uranium determinations showed that higher levels of uranium were found in those veterans with retained metal fragments. A determination was also made during the initial evaluation of these veterans in 1994 and the correlation between the 1994 and 1997 urinary uranium results is highly statistically significant. Neurocognitive examinations demonstrated a statistical relationship between urine uranium levels and lowered performance on computerized tests assessing performance efficiency.

Only nine veterans had U indices above the limit of detection for whole-body counting measurements and all were DU-exposed veterans. The remainder of the results, including those of other DU-exposed veterans, fell below the limit of detection.

An active medical problem list for the participants was assembled during their clinical evaluation. Nearly 90% of the DU-exposed and 71% of nonexposed veterans reported one or more active medical problems. The exposed group most frequently reported sequelae of injuries (76%). Nervous system problems (53%) were most commonly reported by the nonexposed group. Examination of the hematologic, renal, and neuroendocrine laboratory results indicated that, in general, a greater proportion of the DU-exposed veterans was within normal limits for each measure compared to the nonexposed veterans. However, statistical evaluation of the results indicated subtle differences between the high and low DU exposure groups.

Discussion

DU-exposed Gulf War veterans with retained metal fragments are excreting elevated levels of uranium in their urine 7 years after the first exposure. The high correlation between uranium results form 1994 and 1997 reveals a persistent, steady-state excretion of uranium and suggests that excretion is not significantly lowering the body burden of uranium in those with retained metal fragments. Several DU-exposed veterans without retained metal fragments detectable on X ray have urinary uranium values well above the highest nonexposed person's value. The urinary uranium values for the nonexposed group generally agree with literature reports for the unexposed general population.

A semen uranium determination showed that 5 of 22 samples had concentrations above the limit of detection. All samples with detectable levels were from DU-exposed veterans.

In regard to whole-body radiation counting, only 9 of 29 DU-exposed veterans could be identified by their radiation scanning results. They were also among the 14 identified as belonging to the high uranium exposure group based on urinary uranium results.

The active medical problems reported reveal that the DU-exposed veterans were generally more likely to have sustained injuries compared to the nonexposed. However, the exposed veterans were comparable to the nonexposed in musculosketetal and psychiatric complaints. Also, no statistically significant DU-related findings were observed in clinical blood values with the exception of the prolactin findings. Elevated urinary uranium was statistically related to a high prolactin level. The DU-exposed veterans were generally more likely than the nonexposed to have normal complete blood count, urinalysis, and semen parameters.

Mean hematologic parameters compared between low and high uranium groups revealed a higher percentage eosinophils in the high uranium group. Renal perturbations were generally absent. Results revealed no statistically significant differences in renal parameters as a function of urinary uranium. A statistically significant relationship between high prolactin concentration and high urinary uranium was observed in this study. Mean values for physical characteristics of semen examined by the low and high urinary uranium groupings did not show significant differences.

Because of the large number of study variables and the smaller number of participants, the authors were aware of problems associated with making too many statistical comparisons. The vast majority of their comparisons are descriptive. No attempt was made to statistically adjust P values for multiple comparisons.

Conclusions

More than 7 years after first exposure, DU-exposed GW veterans with retained metal fragments continue to excrete elevated concentrations of urinary uranium. The persistence of this finding tempers the meaning of the relatively few uranium-related clinical outcomes documented in this group. Although DU munitions are a significant part of the current military arsenal, the potential for long-term effects in exposed service people must also be weighted.

APPENDIX 15

DEPLETED URANIUM:

INFORMATION FOR CLINICIANS

Prepared by the Depleted Uranium Follow-up Program
Baltimore VA Medical Center
April 2000

Department of Veterans Affairs

DATE: April, 2000

FROM: Medical Director, Depleted Uranium Follow-up Program
Baltimore VA Medical Center

SUBJ: Depleted Uranium: Information for Clinicians

TO: VA Gulf War Physicians and all VA clinicians

1. The Medical Director and staff of the Depleted Uranium Follow-up Program are pleased to provide this packet to assist you with your patients who are concerned about possible Depleted Uranium exposure as a result of their Gulf War service.

2. We have updated our series of fact sheets and guidelines to augment the existing clinical information for VA Gulf War physicians. This document supercedes any previous documents provided by the Depleted Uranium Follow-up Program. In the packet you will find:

Section 1 – Information about Depleted Uranium
- General Information
- Guidelines for Clinicians
- Depleted Uranium Follow-up Program
- References and Further Reading

Section 2 – Medical Issues
- Guidelines for Clinicians

Section 3 – Additional Information
- Further Reading

3. If you have additional questions, please contact the Depleted Uranium Program administrative office at 1-800-815-7533.

MELISSA A. McDIARMID, M.D., M.P.H.

INFORMATION FOR CLINICIANS

Prepared by the Depleted Uranium Follow-up Program
Baltimore VA Medical Center
January 2000

To contact the DU Follow up Program:

Call 1-800-815-7533

or write
Depleted Uranium Program (11DUP)
Baltimore Veterans Affairs Medical Center
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Administrative Officer

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DEPLETED URANIUM: INFORMATION FOR CLINICIANS

1. Information about Depleted Uranium

What is Depleted Uranium?

Uranium, a weakly radioactive element, occurs naturally in soil, water and mineral deposits and is mined and processed primarily for use as fuel in nuclear power reactors. In its pure form, uranium is a silver-white heavy metal nearly twice as dense as lead. Naturally occurring uranium deposits contain over 99% ^{238}U, with small amounts of ^{235}U and ^{234}U (see **table** below).

Depleted uranium is made from natural uranium, by removing some of the more highly radioactive isotopes (^{235}U and ^{234}U). "Enriched uranium," that with the higher concentrations of ^{235}U and ^{234}U, is what is used in nuclear reactors. Depleted uranium is what remains after the enrichment process. It contains even less ^{235}U and ^{234}U than naturally occurring ores. The spent uranium, which is about half as radioactive as natural uranium, is the "depleted uranium". (Voelz)

	Radioactivity	**Natural Uranium**	**Depleted Uranium**
Isotope	µCi/g	Concentration of isotopes	Concentration of isotopes
^{234}U	6200.0	0.0058%	0.001%
^{235}U	2.2	0.72%	0.2%
^{238}U	0.33	99.28%	99.8%
Relative Radioactivity		1	.6

As one may calculate from the table, the radioactivity of natural uranium is approximately 0.70 µCi/g whereas the radioactivity is approximately 0.40 µCi/g.

What is Depleted Uranium used for?

Depleted uranium (DU) has a wide variety of civilian and military uses. It is used in radiation detection devices and radiation shielding for medicine and industry, for components of aircraft ailerons, elevators, landing gear, and rotor blades (AEPI, 1995).

In recent years, the United States Armed Forces have used DU in the manufacture of both projectiles and armor. Uranium's high density and pyrophoric or easily combustible properties makes it, in projectiles, capable of penetrating armor made with less dense metals. Conversely, armor constructed with DU provides a high degree of shielding and resistance to penetration. During the Gulf War (GW), depleted uranium containing munitions were used on a large scale for the first time. In the manufacture of projectiles and armor, depleted uranium is alloyed with small amounts of other metals. (DoD, 1998)

How are soldiers exposed to DU?

When a vehicle is impacted and penetrated by a DU projectile, the projectile splits into small shards, bursts into flames, and fills the insides of the vehicle with flying metal, fumes, and particulates. The bulk of a round may pass directly through the vehicle. The inside of the damaged vehicle remains contaminated with particles of DU and its oxides after the impact. In the event of a vehicular fire, the heat of the fire can cause any onboard DU ammunition to oxidize. Soldiers in struck vehicles may inhale airborne DU particles (or other combustion products), ingest DU particles, and experience wound contamination by DU. Crew members may be left with multiple tiny fragments of uranium scattered through their muscle and soft tissue. Other soldiers may be exposed during operations to salvage tanks that had been disabled by DU rounds or have potential exposure from brief "sightseeing" entry into damaged vehicles.

Who was exposed to DU in the Gulf War?

Initially, approximately 60 military personnel were identified as being wounded by or exposed to DU in a friendly fire incident. Subsequently, the Department of Defense (DoD) has identified additional persons involved in other exposure scenarios. Obviously, greatest potential for medically significant DU exposure occurred with those soldiers who were in or on tanks and other armored vehicles when the vehicles were hit by DU munitions. These individuals were at the greatest risk of being hit by DU fragments and of inhaling fine, suspended DU particles and DU oxides during fires.

Other exposure potential exists for those who entered vehicles immediately after impact to rescue wounded occupants and for those who entered vehicles later to retrieve sensitive items, and/or perform salvage and maintenance on the vehicles. As a result of a fire at Camp Doha, several DU-laden tanks were burned. Those soldiers involved in salvage and maintenance of these vehicles may have also had some exposure to DU. Inhalation of smoke from these burning vehicles provides another opportunity for exposure. For a complete discussion of the opportunities for exposure, please refer to the web site for the Special Assistant for Gulf War Illnesses (OSAGWI) at **http://www.gulflink.osd.mil/envexp.html**.

How does DU get into the body?

Uranium is ingested and inhaled every day from the natural uranium in our air, water, and soil. The amount varies depending upon the natural levels found in the geographic area in which one lives and the levels in the food and water from that area. On average in the U.S., an individual's daily intake of uranium is approximately 1.9 micrograms by ingestion and 0.007 micrograms by inhalation. This intake results in a natural level of uranium in the body of approximately 90 micrograms. It also gives an approximate urine uranium concentration of 0.01 to 0.1 micrograms of uranium per liter of urine. In areas where the natural uranium in the soil or water is high, these levels can be substantially higher (AEPI, 1995).

The uptake and distribution of uranium is in some ways analogous to other heavy metals, such as lead, mercury, arsenic, and cadmium and can enter the body through any of the three common routes of absorption. The principal entry route during on-going exposure is through inhalation of DU vapor and fine dust contamination with DU. Dermal exposure as a result of DU dust contamination of skin or a wound is also possible, however, DU would not be expected to penetrate intact skin. Imbedded, retained DU shrapnel may be dissolved and also be absorbed and distributed throughout the body. Depleted uranium dust can be ingested as well, but is not a likely significant exposure route unless exposure is on-going. Additionally, particles that enter the lungs during inhalation may be incorporated into sputum or phlegm that is raised into the throat and swallowed.

What are the health effects of exposure to DU?

Research on the human health effects of depleted uranium exposure in military occupations is limited, especially regarding DU's potential chemical (rather than radiologic) toxicity. There are, for example, no published epidemiological studies of soldiers exposed to depleted uranium dust or vapor in wartime settings prior to the Gulf War experience. Most of the knowledge about human effects is derived from studies of uranium miners and associated occupations which is not precisely, but only generally relevant to DU exposed

veterans. For example, uranium miners and millers have exposure to uranium but also possibly to radon as well as other toxic substances present in the mines or the ores that are milled, making their health effects experience not directly comparable to those DU exposed. Additionally, exposure intensity and duration of these other occupations are not directly comparable to exposure scenarios in military settings, limiting the applicability of observed health effects in the DU exposure setting.

Acute toxic effects of uranium exposure are manifested primarily in the respiratory system and kidney. In wartime situations, there is the possibility of acute exposure to personnel on, inside, or near (less than 50 meters) vehicles when the vehicles are struck by DU penetrators, when DU munitions or shielding explode and burn. It is theorized that soldiers, particularly those inside tanks, may inhale excessive amounts of DU vapor and dusts raising the question about local effects in the lung as well as systemic effects incurred through an inhalation exposure. The internalization is high enough that it raises the possibility of local irritant effects in the lungs as well as systemic effects following absorption.

Chronic exposure is thought to affect primarily the kidney. The few chronic studies in the literature (as summarized by Voelz, 1992) document renal tubular changes without clear clinical implications. Other epidemiological studies of uranium millers and miners show an increased risk of renal disease. Animal studies have documented both tubular and glomerular lesions in rats given uranium compounds orally. These lesions increased with higher doses of uranium. (ATSDR, 1999). This finding is consistent with the known health effects of other heavy metals. It is unknown if low level, chronic exposure to depleted uranium will cause renal disease, although up to now, no renal abnormalities have been seen in the DU exposed friendly fire cohort being followed at the Baltimore VA.

Chronic exposure by inhalation presents a potential radiologic hazard to the **lung**. Uranium miners have a long occupational history of inhaling uranium dust in closed spaces. There is an increased risk of lung cancer among uranium miners but this is thought to be due to the simultaneous exposure to radon. The animal data are insufficient to determine whether inhalation of natural uranium causes lung cancer in animals.

Concerns about genotoxicity, mutagenicity and reproductive effects are only beginning to be studied, and definitive answers to these questions will almost certainly take much more work. Animal cell lines treated with uranium in one study have shown possible genotoxic and/or mutagenic changes. No chromosomal aberrations have been seen in the DUP group to date. Reproductive effects in humans exposed to uranium have not been studied. To this point, there have been no birth defects in the 20 or so children born to the GW veterans in the DU Follow-up Program. These are the people who have had the greatest exposure to DU, including several with imbedded DU shrapnel in their bodies.

The ATSDR Toxicological Profile on Uranium summarizes the existing animal and human data on uranium. (See ordering information in the Section on Further Reading)

What is the potential for external radiation exposure?

External exposures, that is when DU is not taken directly into the body, result in minimal radiation exposure because DU, an alpha emitter, has relatively poor penetrating ability. Direct contact with DU munitions for 250 hours is necessary to exceed annual occupational exposure limits. Wearing gloves provides effective protection against this type of exposure. Crew members inside an M1 or M1A1 tank fully uploaded with intact DU munitions average dose rates far below annual occupational whole-body exposure limits.

What is the potential for internal radiation exposure?

Internal exposure, whether via inhalation, ingestion, wound contamination or retained shrapnel warrants concern. Uranium's main radioactive emissions (i.e., alpha particles) "…are unable to penetrate skin, but can travel short distances in the body and cause damage…" (ATSDR Toxicological Profile, 1999). Concern about cell damage due to radiation exposure from DU should be tempered with the knowledge that depleted uranium is less radioactive than the naturally occurring uranium found in soil and water.

The radiation dose assessments indicate that the internal radiation exposure to the most highly exposed group (personnel in or on a vehicle when it was struck by DU munitions) are on the order of tenths of a rem. All other potentially exposed personnel received radiation doses significantly less than the highest exposed group. Nonetheless, an assessment of whether DU exposure is internal and a commitment to regular medical follow-up for heavily exposed persons are prudent clinical and public health activities.

Looking at the natural background radiation exposure is one method of placing the radiation exposure from DU into perspective. Ionizing radiation exposure to the U.S. population comes from a variety of sources. The total ionizing radiation exposure that a resident of the U.S. receives on average is about 0.3 rem per year from natural and man-made sources. This is in the range of the exposures received by the most highly exposed population. The largest single source (inhalation) is primarily due to indoor radon. Natural background levels vary with geographic location and may be significantly higher.

The risk from this exposure is well below the risk of other commonly accepted risk factors as shown in the **table** below. The information is from the Nuclear Regulatory Commission Regulatory Guide 8.29.

Health Risk	Life Expectancy Loss
Smoking 20 cigarettes per day	6 years
Overweight by 15%	2 years
Alcohol consumption (U.S. average)	1 year
All accidents combined	1 year
All natural hazards combined	7 days
Medical radiation	6 days
Occupational exposure	
0.3 rem/yr (18 to 65 yrs)	15 days
1.0 rem/yr (18 to 65 yrs)	51 days

The DoD has described the following scenarios and their associated radiation dosages:

- A driver inside a fully loaded “heavy armor” tank, which uses DU armor panels, for 24 hours a day, 365 days a year would receive a dose of less than 25% the current occupational limit of 5 rems.

- The current dose limit for skin (50 rems in a year) would only be exceeded if unshielded DU remained in contact with bare skin for more than 250 hours. (DoD, 1998)

Are there other toxic effects of exposure to DU?

The original concern about health effects from DU exposure was primarily the potential radiologic hazard that exists. Separate from its radiologic properties however, uranium is also a heavy metal, a chemical toxicant that exhibits some adverse health effects similar to other heavy metals, such as lead and cadmium. The kidney effects, for example (proximal tubular and, possibly, glomerular) are likely a result of the chemical toxicity of uranium, rather than its radiologic toxicity. The mutagenicity data, although extremely limited, are

also probably due to uranium's chemical properties. This distinction is important because it suggests possible health outcomes in an affected population, as well as a knowledge base (which exists for other heavy metals) with which to compare the extremely limited findings observed in the DU exposed participants.

Insights into successful interventions, treatment strategies and refined prognoses may also be gained from the heavy metal literature. The chemical nature of DU will thus be an additional focus for the on-going follow-up program.

2. The Depleted Uranium Follow-up Program

What is the Depleted Uranium Follow-up Program (DUP)?

The DVA Depleted Uranium Follow-up Program (DUP) at the Baltimore VA Medical Center is a clinical surveillance program for identifying, characterizing and following individuals with retained DU fragments and those exposed to DU as a result of their involvement in "friendly fire" incidents during the Gulf War.

The specific **aims** of the project are to provide on-going clinical surveillance of Gulf War veterans with known or suspected imbedded DU fragments, DU contaminated wounds or significant amounts of inhaled DU. This clinical surveillance will detect health effects, if any, of DU containing shrapnel, and provide recommendations for treatment to participating veterans and physicians caring for them.

Focused research into the toxicological and radiological effects of DU is intended to improve the scientific basis for advice about fragment removal, to better model uranium absorption, distribution in tissue, and excretion, and to develop improved methods to assess uranium dose *in vivo*. In addition, the program hopes to improve methods of detection of toxic effects from low dose uranium exposure.

In 1998, in response to the concerns of other Gulf War veterans that they might also have been exposed, the VA and DoD expanded the DU program to provide urine testing for any Gulf War veteran who requested it (VHA Directive 98-023). The testing is part of the Comprehensive Clinical Evaluation Program for active duty personnel and the Gulf War Registry program for military veterans. As part of these programs, an individual may submit a 24-hour urine sample for total uranium concentration. A self-report DU exposure history is also completed and submitted with the specimen. More detail about this part of the DUP may be found on page 180.

Who is participating in the initial DUP?

Initially, 33 Gulf War veterans (some still on active duty), who had been on or in U.S. Army vehicles when struck by DU containing munitions were evaluated at the Baltimore VA Medical Center in 1993 and 1994. Many of these soldiers had been wounded and about half were thought to have retained shrapnel.

In 1997, these same participants were invited to return to Baltimore for another evaluation. In addition to the 29 who returned, a group of non-exposed Gulf War veterans were recruited to serve as a comparison population for the clinical findings from the initial group.

In 1999, the original group was invited to return for a 3rd evaluation. Through the efforts of the VA and the DoD, additional Gulf War veterans who had been involved in friendly fire incidents were identified. Contact was made with as many of these people as possible and they were invited to come to Baltimore as participants in the Follow-up Program. Thirty additional participants were added to the 21 original people who chose to return.

What health effects have been found in this group?

Of the total of 63 Gulf War veterans who have been evaluated since 1993, approximately 25% have evidence of retained shrapnel. Those with retained DU shrapnel have the highest urine uranium levels and continue to excrete uranium in their urine 9 years after being wounded (Hooper, 1999).

There is a relationship between urine uranium levels and prolactin levels, a neuroendocrine hormone. Most of the higher prolactin levels, however, are within the upper limits of normal and the clinical significance of this finding is unclear. There is some evidence of uranium in the semen of those with the highest urine uranium levels. However, this was observed in only some of these DU exposed and did not correlate with urine uranium levels. These studies are being repeated currently. At least 20 children have been born to the DU exposed group and none suffer birth abnormalities. These clinical findings are from the 1997 surveillance (McDiarmid, 2000). These parameters were examined again in 1999. The data from the 1999 surveillance is still being analyzed, but no major differences have been noted when compared to the 1997 data.

Some subtle differences are noted in performance on computer-based neuropsychological tests between those with higher urine uranium levels and lower urine uranium levels. These findings are not seen, however, on traditional paper and pencil tests and so their clinical significance is unclear. This area also continues to be studied.

What is the DUP doing for these participants?

All participants were evaluated at the Baltimore VA Medical Center and underwent a comprehensive medical and psychological evaluation as well as a full body skeletal x-ray survey. Physiologic parameters including routine blood chemistries and hematology, renal function, neuroendocrine hormone function, pulmonary function, semen analysis, and genotoxicologic factors were examined. Neuropsychological and psychiatric test batteries were completed.

The DUP has facilitated the assignment of primary care providers for the veterans in the group and interfaces with those primary care providers as needed. All lab and test results are forwarded to the primary care providers as they become available. The DUP serves as a resource with respect to information about DU, its measurement, and its health effects for the primary care providers as well as for any military or VA health care institution.

An 800-telephone number has been made available to participants as well as their family members and healthcare providers for consultation and assistance in a variety of clinical and personal issues. The staff has expertise and experience in the area of environmental and occupational health, particularly with regard to the effects of heavy metal exposure.

Who is participating in the expanded program?

As mentioned, before, the responsibilities of the DUP were expanded in 1998 to include the coordination of urine uranium testing for any veteran of the Gulf War who requests it, as part of the Gulf War Registry for veterans or the CCEP for active duty personnel. Prior to 1998, approximately 50 urine samples were submitted for urine uranium testing. Since the inception of the enlarged program, various VA and military health care providers have requested over 450 urine kits from the DUP. Over 270 samples have been returned and analyzed. When the results are compiled, they are sent to both the individual participant and the health care provider at the facility that originated the request.

What are the findings from this group?

Only a very few participants (<5%) have provided urine samples with total uranium levels above 0.05 µg/g creatinine, which is our cut point for what is a likely upper limit (though a conservative one) from dietary sources or uranium. In fact, most are at least 2 orders of magnitude lower than the highly exposed group.

If a result is higher than what would be expected to occur from ingestion of natural uranium, the participant is called and the detailed history of his/her Gulf War experience submitted with the urine sample in questionnaire form is verbally reviewed with the veteran, by the DU nurse clinician. Occupational or environmental exposures are also explored. The

participant is asked to provide another specimen for repeat analysis to confirm the original result. An aliquot of the sample is also sent for isotopic analysis to attempt to determine the source of the uranium, natural or DU.

Does the DU Program work with other groups involved in DU research?

The DU program has developed a collaboration of VA and non-VA academic experts in the field of exposure characterization and outcome measurement. A team of specialists in environmental and occupational health, epidemiology, toxicology, radiobiology, physics, psychiatry, neuropsychology, and reproductive health have worked individually and collectively to develop and adapt diagnostic tools to better evaluate, treat and counsel this unique group of soldiers and veterans.

What kinds of outreach and assistance efforts have been provided to non-participants and the community at large?

Consultation: The program has been involved in outreach activities to other VA medical centers, serving as a clearinghouse for questions raised by veterans about uranium exposures. These inquiries involve veterans who were not wounded but may have, or think they may have inhaled or been in proximity to uranium because of their active duty participation during the Gulf War or during maintenance, clean up and repair of vehicles containing depleted uranium. While at much lower risk than program participants, these individuals still have questions for their VA physicians. The program aids their physicians with advice about the best ways to assess the risks of past depleted uranium exposure and how to assess these exposures clinically.

Communication: The staff of the DU Program serve as a resource for requests for information from healthcare providers, government and private sector news publications, VA Headquarters, the Presidential Advisory Committee on Gulf War Veterans' Illnesses, and others.

3. Guidelines for Clinicians

What can I do if a patient suspects possible past DU exposure as a result of military service in the Gulf War?

If a patient suspects possible past DU exposure, he/she must first complete the Gulf War Registry Exam for veterans or the Comprehensive Clinical Evaluation Program for active duty personnel. A careful history of past and present exposures is critical to this process.

Once enrolled in either of these programs, the patient is eligible to complete the evaluation for DU. This evaluation includes the submission of a 24-hour urine and the completion of exposure questionnaires.

To initiate the process of this evaluation, place a call to the DUP to request a urine testing kit. Be prepared to provide the name and social security number of the patient as well as the mailing address and name of the responsible health care provider/coordinator at the local site who will be managing the collection of the sample. The kit will be sent by express mail (FedEx) and should arrive within about a week or the phone request. Detailed and explicit instructions for the collection of the sample and questionnaires and their return are included in the kit.

Tips for taking the history

Listen for the patients concerns about their Gulf War exposures and experiences. Veterans are hearing information and advice from a wide variety of sources. Encourage the patient to ask questions and express their concerns. Given the amount of public discussion of possible sequelae, it is not surprising that veterans will wonder about the possible significance and prognosis of any type of new symptom in themselves or their family members. In the first round of evaluations we uncovered serious concerns about the possible deeper meaning of problems as common and generally benign as otitis media in toddlers, and tinea versicolor. Such concerns and apprehensions won't be relieved if they don't get discussed.

Ask the patient to provide a **detailed description** of all occupations including the current occupation. Focus on the situation that had the **potential DU exposure**. Probe for specific details about job duties, the equipment used, the nature of the site, the protective equipment worn, the training required and the hazard information provided. Obtain information about how and why the veteran believes he or she was exposed to Depleted Uranium. Patients can often provide quite accurate and detailed exposure information and, may, even have been provided hazard communication training and materials.

It is always important to determine **the length of time** the patient may have been exposed. For example, how many hours did the soldier spend cleaning tanks potentially contaminated with DU dust. Determine if the exposure occurred via inhalation, ingestion or dermal (wound contamination). The clinician can reassure most concerned patients by pointing out that in the cohort with imbedded, retained DU shrapnel, so far, no adverse health conditions have been detected. The clinician should emphasize that retained shrapnel represents continuous, internal exposure and, as such, is more potentially hazardous than other military exposures as currently understood. The clinician can further re-assure the patient by assessing uranium excretion. (See next section.)

When evaluating any symptoms or abnormal lab values that the veteran or soldier has, **be sure to include a complete discussion of any present exposures, whether occupational or environmental in the differential diagnosis.** For example, if the individual complains of shortness of breath, has he/she had a **recent exposure** to any pulmonary toxicants? If there are CNS symptoms, has there been **recent contact** with solvents, paints, degreasers, etc. A present occupational or environmental exposure is more likely to be causing current problems than a previous exposure to DU in the Gulf.

Laboratory tests for uranium

The only practical, biologic measure readily available to assess uranium exposure clinically is to measure urine excretion of uranium. If internal DU exposure is suspected, the clinician should call the DU Program to obtain the kits used to collect the 24-hour urine specimen for uranium. The DU Program at the Baltimore VAMC will facilitate processing and interpretation of the results. The results are available in six to eight weeks and the clinician will be notified with the results and interpretation. Other possible methods for assessing DU exposure and body burden are being developed and are not appropriate for routine, clinical use.

Points of contact for the DUP

To contact the DU Follow up Program:
Call 1-800-815-7533

or write
Depleted Uranium Program (11DUP)
Baltimore Veterans Affairs Medical Center
10 N. Greene Street
Baltimore, MD 21201

The staff of the DU Program has a unique expertise in the evaluation of risk, clinical assessment and treatment of exposure to depleted uranium. Based on their experience with DU and other heavy metal exposures, they are available to provide:

- general information regarding depleted uranium
- determination of possible exposure
- assessment of risk
- guidance in determining appropriate medical testing
- assistance in obtaining and interpreting urine uranium results
- advice for counseling DU-exposed personnel
- referral to other specialists for individualized problem solving

4. References and Further Reading

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U.S. Nuclear Regulatory Commission (1996). Regulatory Guide 8.29. Instructions concerning risks from occupational radiation exposure. Office of Nuclear Regulatory Research.

Voelz, George L. (1992). Chapter 13. Uranium in Hazardous Material Toxicology Eds. Sullivan, John B. and Krieger, Gary R.Williams and Wilkins, Baltimore, MD.

Additional Resources

Agency for Toxic Substances and Disease Registry (ATSDR). U.S. Public Health Service. Toxicological Profile for Uranium (Update). Can be ordered from:
National Technical Information Service
5285 Technical Information Road
Springfield, VA 22161
Phone: (800) 553-6847 or (703) 605-6000

Armed Forces Radiobiology Research Institute, Technical Report 93-3, Depleted Uranium: Questions and Answers. Prepared by: CDR Eric E. Kearsely, MSC, USN and LTC Eric G. Daxon, MS, USA

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Gulf War Illness

Institute of Medicine, Committee to Review the Health Consequences of Service During the Persian Gulf War, *Health Consequences of Service During the Persian Gulf War: Initial Findings and Recommendations for Immediate Action* (Washington, DC: National Academy Press, 1995)

**Presidential Advisory Committee on Gulf War Veterans Illnesses: Interim Report* (Washington, DC: U.S. Government Printing Office, February 1996)

On the Internet

GulfLINK (**http://www.gulflink.osd.mil/**) is the World Wide Web information system of the Office of the Special Assistant for Gulf War Illnesses that provides the public with information concerning the illnesses affecting Gulf War veterans. Information is updated periodically and covers a wide range of topics.

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* These citations can be found on the GulfLINK web site described above.

† Journal articles written by the DUP staff and program collaborators. URLs for the article abstracts are listed below the citations if available.

†† Journal articles written by DUP staff and program collaborators. Copies of abstracts attached to this document. Permission to attach them has been received by the publisher.

APPENDIX 16

From: CIRRPC Science Panel Report #6, 1998

Table 3. Screening Doses (in rad) to the Affected Organ/Tissue Based on Upper 99-Percent Credibility Limit[1]

Type of Cancer	Age at Exposure <20	30	>40
Chronic granulocytic leukemia[2]			
within 20 years of exposure	0.9	1.3	1.4
20 or more years post-exposure	2.7	3.2	5.9
Acute leukemia[2]			
within 20 years of exposure	1.1	1.8	4.1
20 or more years post-exposure	3.5	4.1	5.5
Leukemia (excl. chronic lymphatic)			
within 20 years of exposure	1.1	1.7	3.3
20 or more years post-exposure	3.3	3.9	5.5
Colon cancer	17.0	33.1	58.1
Esophageal cancer	3.9	9.9	16.7
Female breast cancer	18.8	37.0	78.6
Kidney and bladder cancer	13.4	23.1	34.7
Liver cancer	1.0	3.3	8.2
Lung cancer			
known smokers[3]	25.5	48.8	72.1
others[4]	4.3	9.3	15.0
Pancreatic cancer	5.8	13.7	24.3
Stomach cancer	6.9	13.8	23.2
Thyroid cancer	3.3	7.4	8.8

1 *A claim should be further developed for causality if the claimant's organ/tissue dose exceeds the values given the table. Screening doses between ages 20 end 30 or between 30 and 40 should be obtained by linear interpolation. A claimant with a dose less than the screening dose would have less than a one percent chance of having a true PC exceeding 0.5 (50%).*

2 *Dose to active bone marrow.*

3 *Known to have been a regular smoker (10 or more cigarettes per day) within 5 years of diagnosis. Screening doses are calculated based on the assumption that the claimant is a member of the average U.S. population that includes smokers and nonsmokers.*

4 *Claimant's smoking habits are unknown or claimant is known to have stopped smoking 5 years or more prior to diagnosis, or claimant is known to be a nonsmoker. Screening doses are calculated based on the assumption that the claimant is a nonsmoker.*

Veterans and Radiation

Independent Study Test Questions for CME Credit

Using the Independent Study Participant Registration/Answer Sheet, please completely fill in the lettered box corresponding to your answer next to the appropriate number.

1. **The main difference between ionizing radiation and non-ionizing radiation is**:
   a) Ionizing radiation releases energy more rapidly
   b) Ionizing radiation is twice as radioactive as non-ionizing radiation
   c) Ionizing radiation creates electrically-charged particles
   d) All of the above

2. **Which of the following is not a form of ionizing radiation?**
   a) Alpha particles
   b) Beta particles
   c) Gamma waves
   d) Microwaves

3. **Which of the following is not a form of non-ionizing radiation?**
   a) Gamma waves
   b) Microwaves
   c) Infrared waves
   d) Extremely low frequency (ELF) electric power

4. **Which of the following is an example of a "stochastic" effect of radiation?**
   a) Cataracts
   b) Acute radiation syndrome
   c) Leukemia
   d) Pulmonary fibrosis from radiation therapy

5. **Which of the following is an example of a "deterministic" effect of radiation?**
   a) Cataracts
   b) Genetic mutation
   c) Leukemia
   d) Thyroid cancer

6. **How do malignancies caused by ionizing radiation differ from malignancies caused by other factors?**
   a) Increased p53 levels
   b) Indistinguishable
   c) Increased angiogenesis factors
   d) Increased 26q trisomy

7. **Which form of non-ionizing radiation is thought to be the major risk factor for skin cancer?**
   a) Infrared
   b) Ultraviolet
   c) Microwave
   d) Radiofrequency

8. **According to the National Academy of Sciences, the likelihood of "deterministic" effects from ionizing radiation would be very low at doses of less than**
   a) 500 rem
   b) 100 rem
   c) 50 rem
   d) 10 rem

9. **Which group of veterans is not eligible for inclusion into the VA's Ionizing Radiation Registry examination program database?**
   a) Hiroshima and Nagasaki occupation troops
   b) Nuclear submarine crew members
   c) Participants in atmospheric nuclear weapons tests
   d) Submariners treated with nasopharyngeal (NP) radium

10. **The current annual whole-body occupational radiation dose limit mandated by the Nuclear Regulatory Commission is**
    a) 50 rem
    b) 5 rem
    c) 0.5 rem
    d) 0.05 rem

11. **The maximum dose estimated to have been received by U.S. occupation troops at Hiroshima or Nagasaki according to the Defense Threat Reduction Agency is**
    a) 0.1 rem
    b) 1 rem
    c) 10 rem
    d) 100 rem

12. **The average external radiation dose that atmospheric nuclear weapons test participants are estimated to have received according to the Defense Threat Reduction Agency is**
    a) 160 rem
    b) 60 rem
    c) 6 rem
    d) 0.6 rem

13. **Which of the following adverse health effects has not been found in studies of Japanese atomic bomb survivors?**
    a) Increased risk for birth defects in offspring conceived after exposure
    b) Increased risk for leukemia
    c) Increased risk for thyroid tumors
    d) Increased risk for breast cancer in women

14. **Which of the following statements about studies of U.S. atmospheric nuclear weapons test participants is incorrect?**
    a) Some studies have found increased risks for leukemia and lymphopoetic malignancies
    b) Some studies have found increased mortality risk for various solid tissue malignancies
    c) Some studies have not found an increased risk for overall mortality
    d) Some studies have found an increased risk for birth defects in offspring

15. **Which of the following adverse health effects has been linked to treatment with nasopharyngeal (NP) radium in some studies?**
    a) Increased risk for malignant mesotheliomas of peritoneum
    b) Increased risk for esophageal cancer
    c) Increased risk for tumors of the head and neck
    d) Increased risk of cataracts

16. **Compared to natural uranium, approximately how radioactive is depleted uranium (DU)?**
    a) Twice
    b) Equal
    c) Half
    d) One-tenth

17. **Which currently appears to be the best method to screen for significant amounts of internalized depleted uranium (DU)?**
    a) Whole body external counting for radioactivity from uranium
    b) Plutonium bioassay determination
    c) Measurement of radon expired from the lungs
    d) Urinary uranium determination

18. **Which of the following health effects has not been found in some veterans with retained depleted uranium (DU)?**
    a) Increased urinary uranium excretion
    b) Reduced performance on some computerized neuropsychological tests
    c) Higher prolactin values
    d) Increased risk for birth defects in offspring

19. **Which Gulf War veterans are eligible to participate in the VA's DU screening program?**
    a) Friendly-fire casualties
    b) Personnel who salvaged vehicles damaged by DU munitions
    c) Other Gulf War veterans who are concerned about possible DU exposure
    d) All of the above

20. **Cataracts possibly due to radiation exposure would be best managed by a**
    a) Specialist in ophthalmology
    b) Radiation safety officer
    c) Radiation epidemiologist
    d) Specialist in chelation therapy